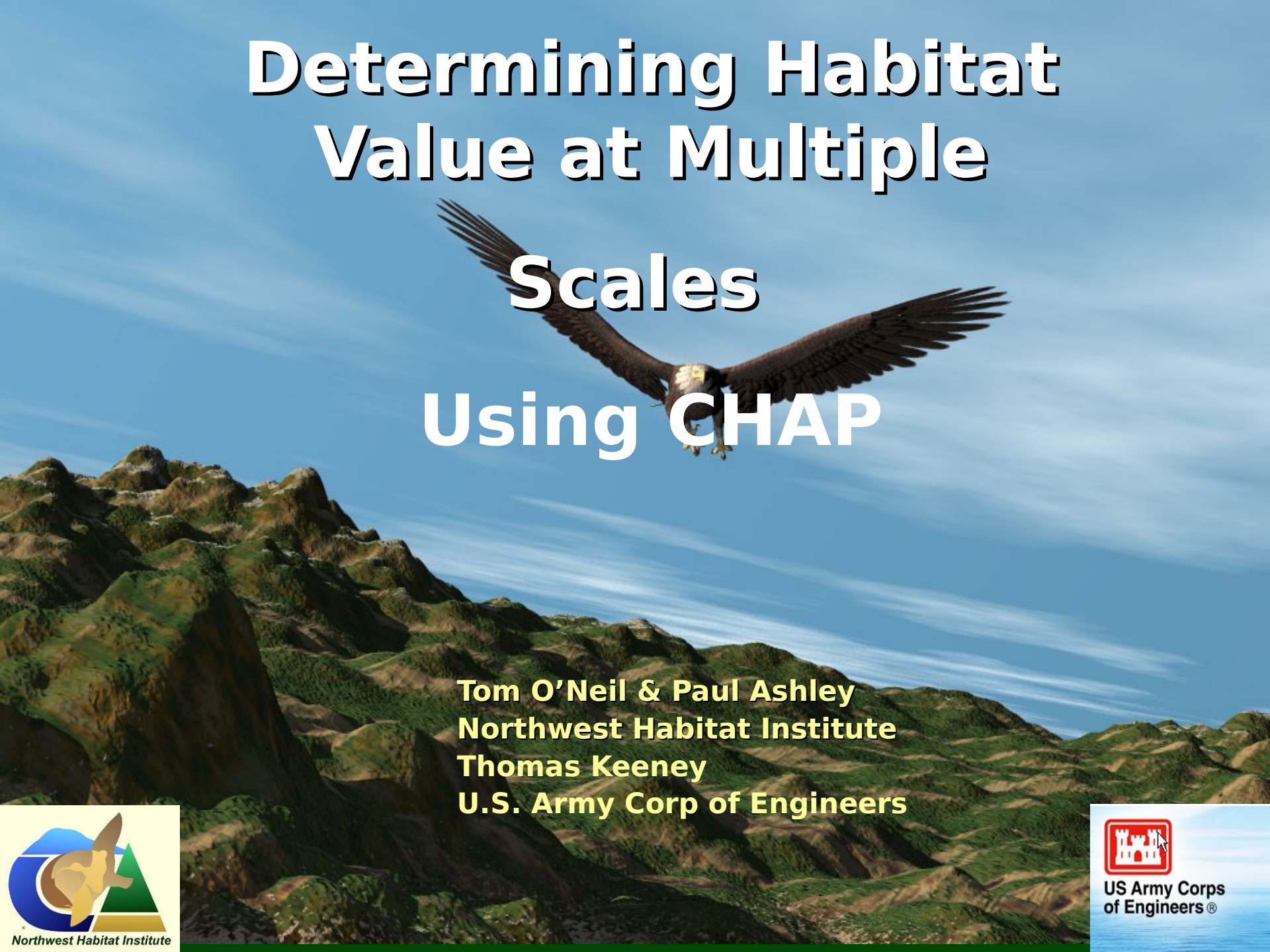
Determining Habitat Value at Multiple Scales Using CHAP



Tom O'Neil & Paul Ashley
Northwest Habitat Institute
Thomas Keeney
U.S. Army Corp of Engineers

Northwest Habitat Institute

US Army Corps of Engineers®

Outline

- Approach
  - Habitat Appraisal and Bart
    (HAB) overview
  - Habitat Evaluation Procedu
    (HEP) briefly
- Results
- Tools and products
- Conclusions

Introduction

Why do we need a consistent methodology for habitat assessment?

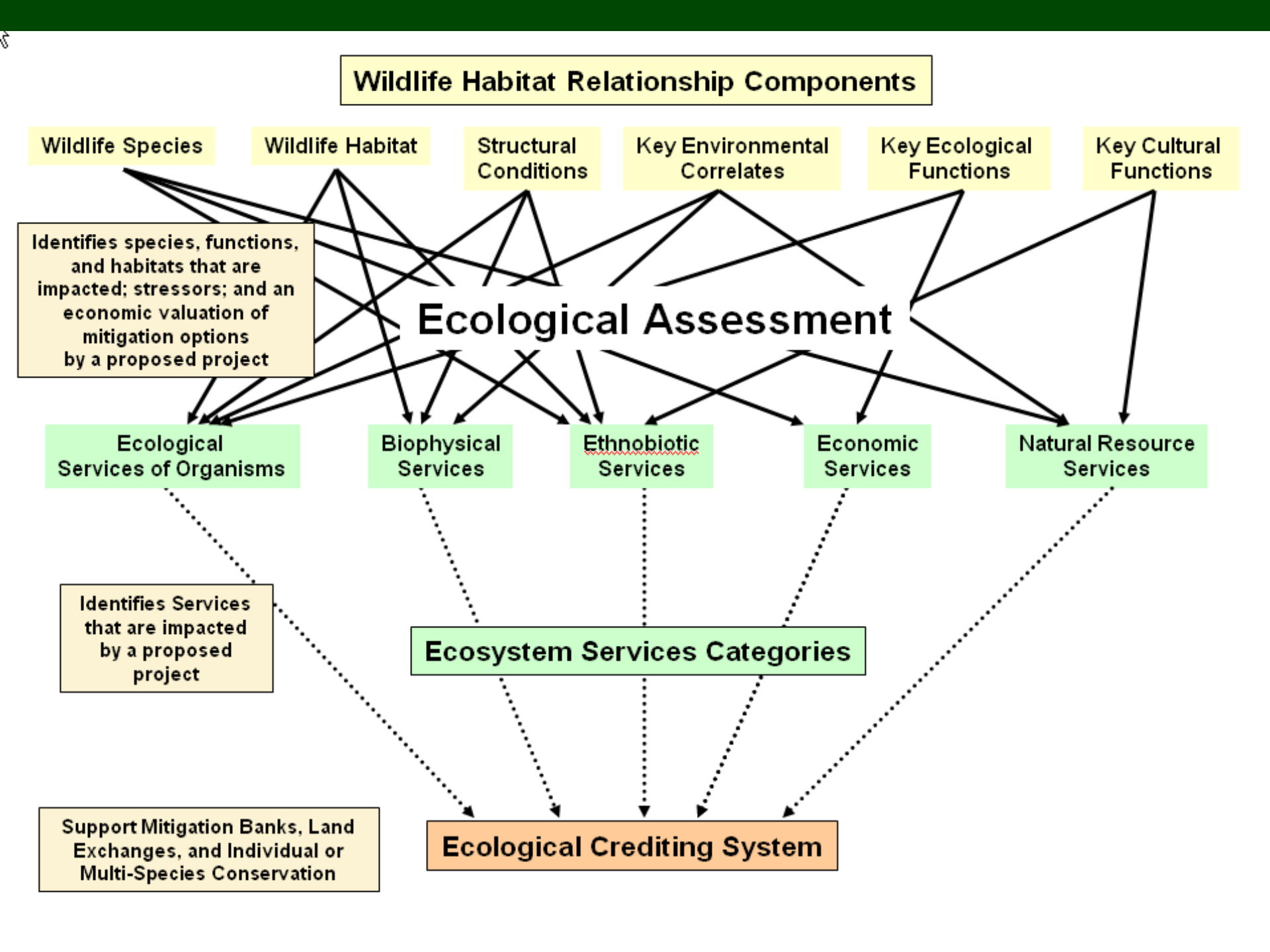
- Various methods exist for assessing baseline habitat conditions depending on:
  - Location of project
  - Agencies involved
- Comparisons of findings difficult
- No unified ecological picture

Approach

1) Universal wildlife habitat classification system
2) Relational database that ties multiple species to specific habitat types
3) Consistent wildlife habitat mapping met

Habitat Assessment Process

- Ecologically Comprehensive
- Linkage and Legacy
- Easily Understood
- Scientifically Based
- Referenced


Wildlife Habitat Relationship Components
Wildlife Species
Wildlife Habitat
Structural Conditions
Key Environmental Correlates
Key Ecological Functions
Key Cultural Functions
Identifies species, functions, and habitats that are impacted; stressors; and an economic valuation of mitigation options by a proposed project
Ecological Assessment
Ecological Services of Organisms
Biophysical Services
Ethnobiotic Services
Economic Services
Natural Resource Services
Identifies Services that are impacted by a proposed project
Ecosystem Services Categories
Support Mitigation Banks, Land Exchanges, and Individual or Multi-Species Conservation
Ecological Crediting System

Integrated Habitat and Biodiversity Information System (IBIS)

Lessons Learned from the Spotted Owl Listing

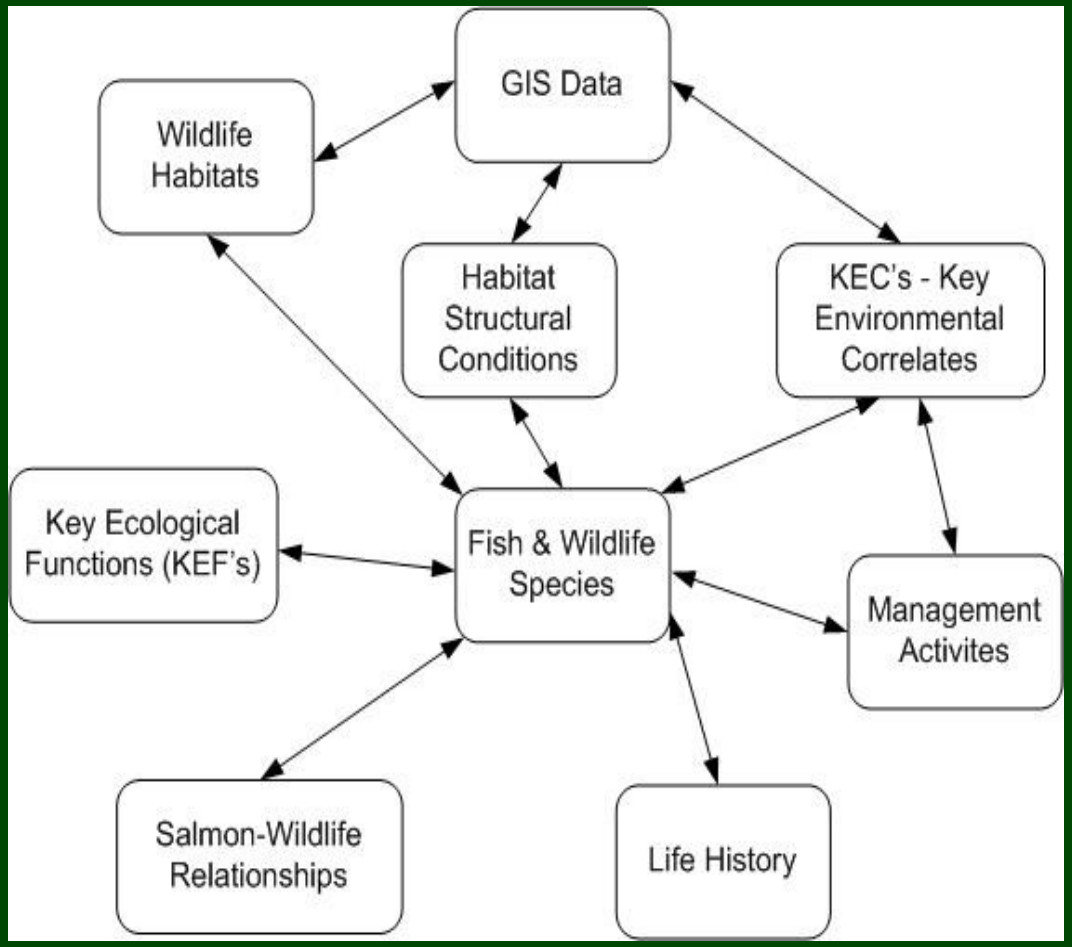
- Interagency supported and developed

5 Teams – Senior Science (Overall Guidance), Species-Habitat, Management, Marine, and Data/Digital Products

Goal: *To Facilitate Common Understanding For Management*

Relational Database

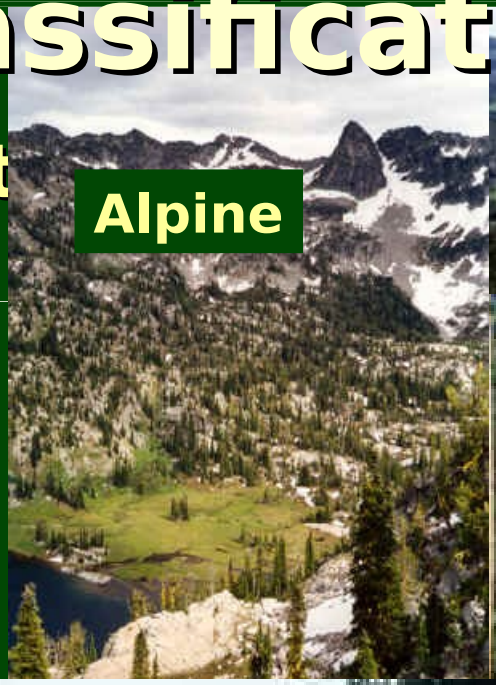
IBIS



- IBIS contains extensive information on fish and wildlife species
- Information includes species ecological functions, life histories, habitats, and impacts of various management

Wildlife Habitat Classification

32 Wildlife-Habitat Types are consistently identified
(Johnson & O'Neil, 2001)



Wildlife Habitat Classification

Agriculture
Row Crop

Medium Tree
Single Story Open

Medium Tree
Single Story Moderate

47 Structural Conditions and Land Uses are consistently identified

Wildlife Habitat Classification

Key Environmental Correlates (KECs)

Habitat elements (physical or biological) thought to most influence a species distribution, abundance, fitness, and viability

> 200 KECs identified

Key Environmental Correlates (KECs)

Example

Northern River Otter has 57 KECs

- down wood in riparian areas
- beaver/muskrat activity (dams, lodges, ponds)
- burrows (aquatic or terrestrial)
- oxbows
- overhanging vegetation
- coarse woody debris in streams and rivers
- ephemeral pools

Species List Determined by:

- Occurrences
  - State/County
  - Range Maps
  - Survey/Museum Records
- Life History
  - Elevation Ranges
- Habitat Associations
  - Habitat Type
  - Structural Conditions
  - KECs from field inventory

Key Ecological Functions (KEFs)

The principal way organisms influence the environment

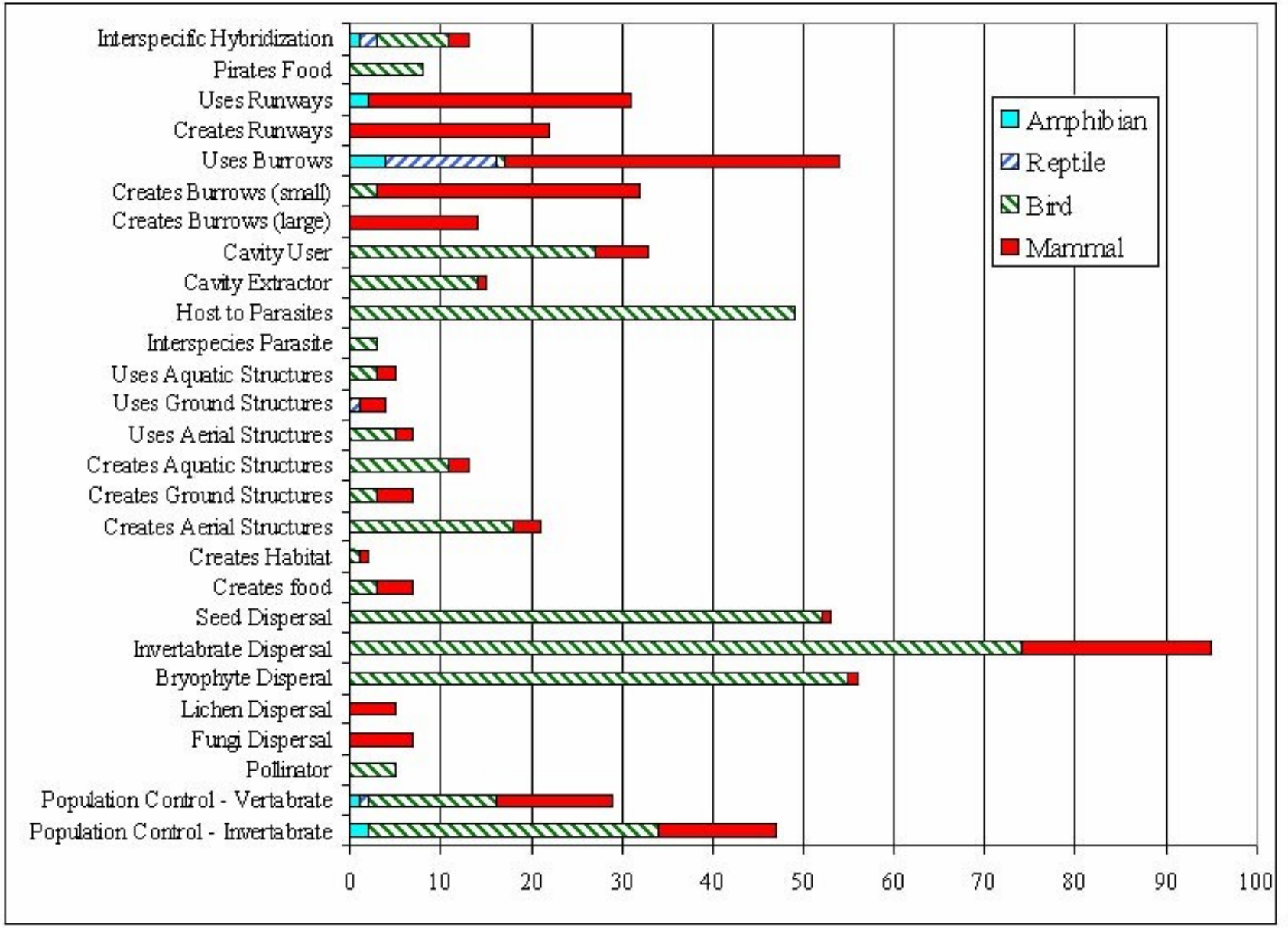
Key Ecological Functions (KEFs):

Example

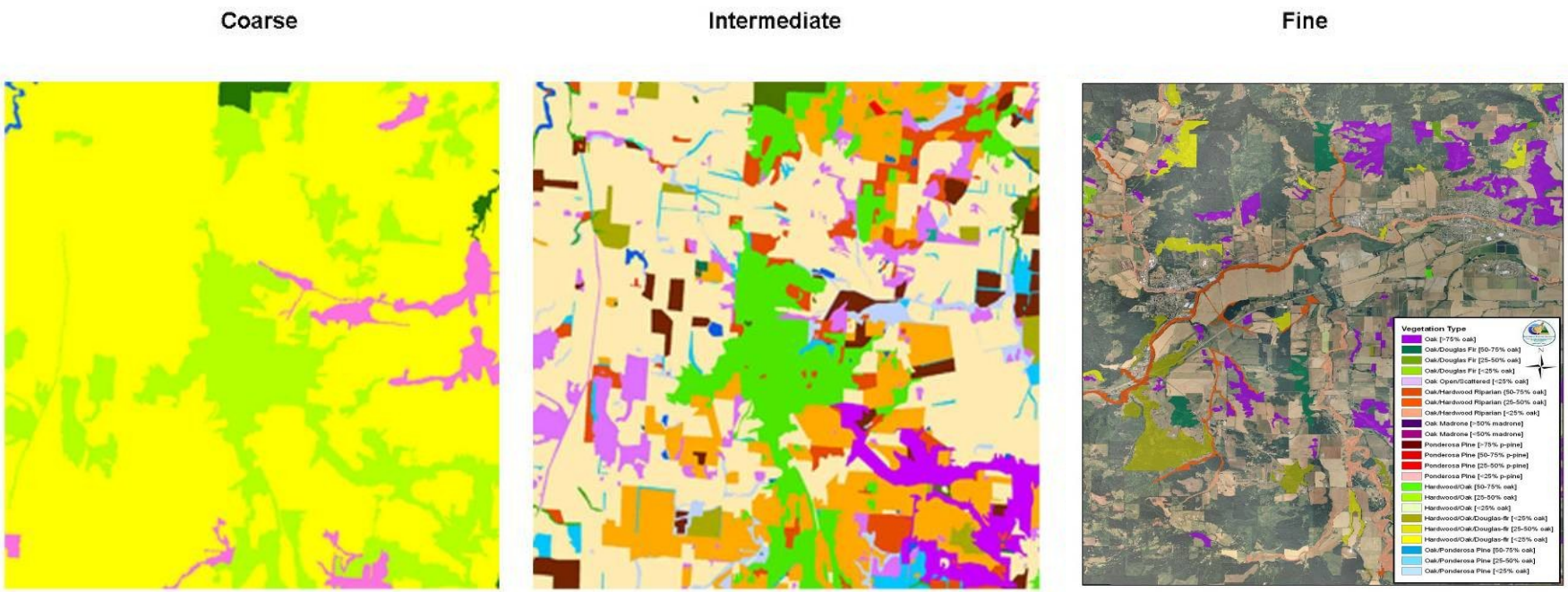
Northern River Otter has 12 KEFs

piscivorous
secondary burrow user
creates runways
eats aquatic macroinvertebrates
eats terrestrial invertebrates

Key Ecological Functions



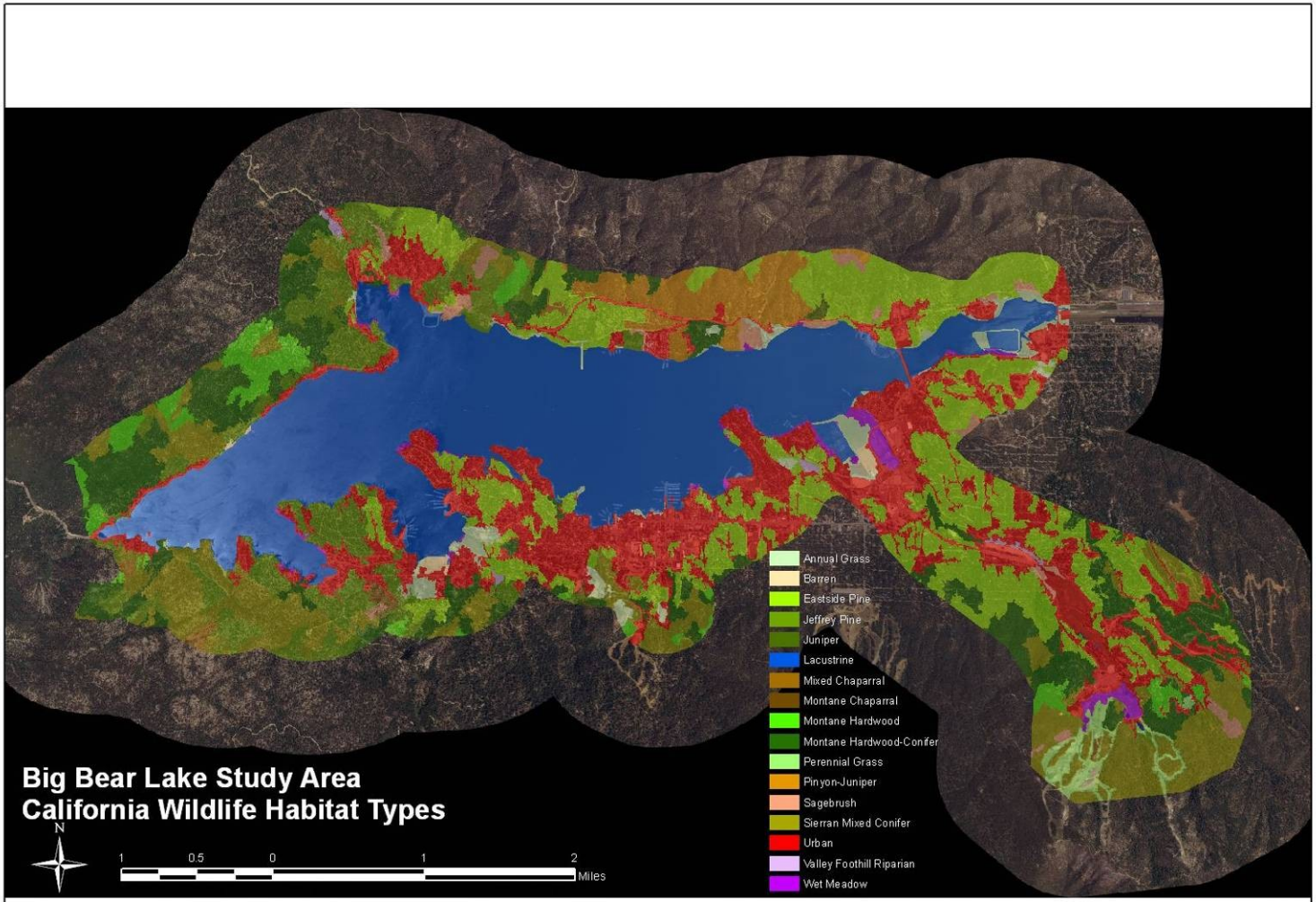
Mapping Wildlife Habitats

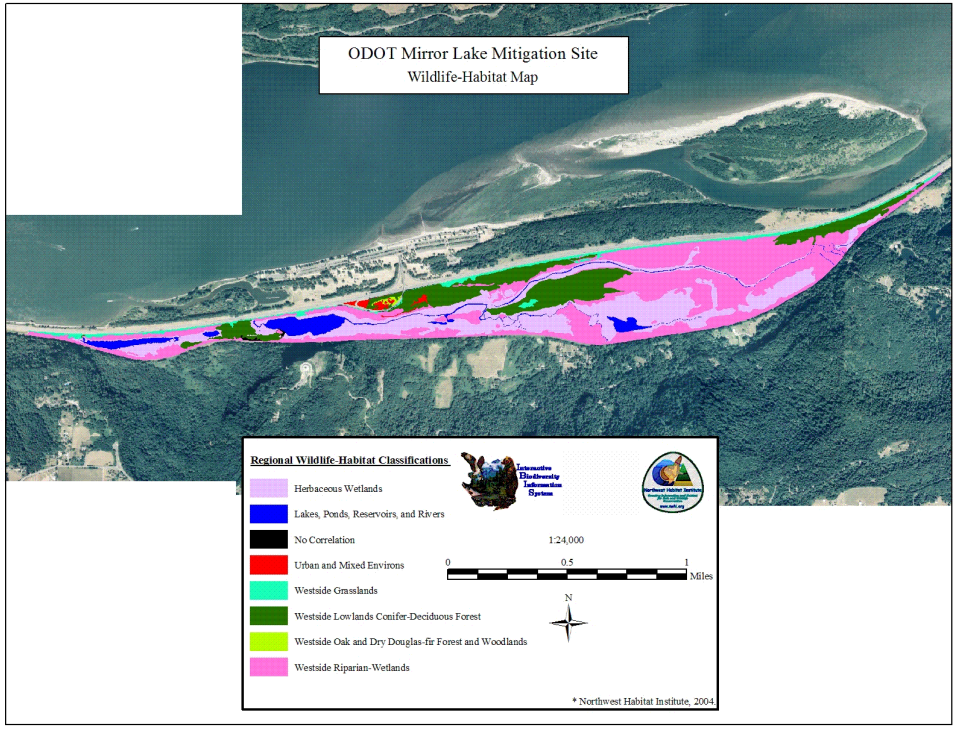


Mapping methodologies that combines both the habitat classification scheme and relational databases at various hierarchical scales

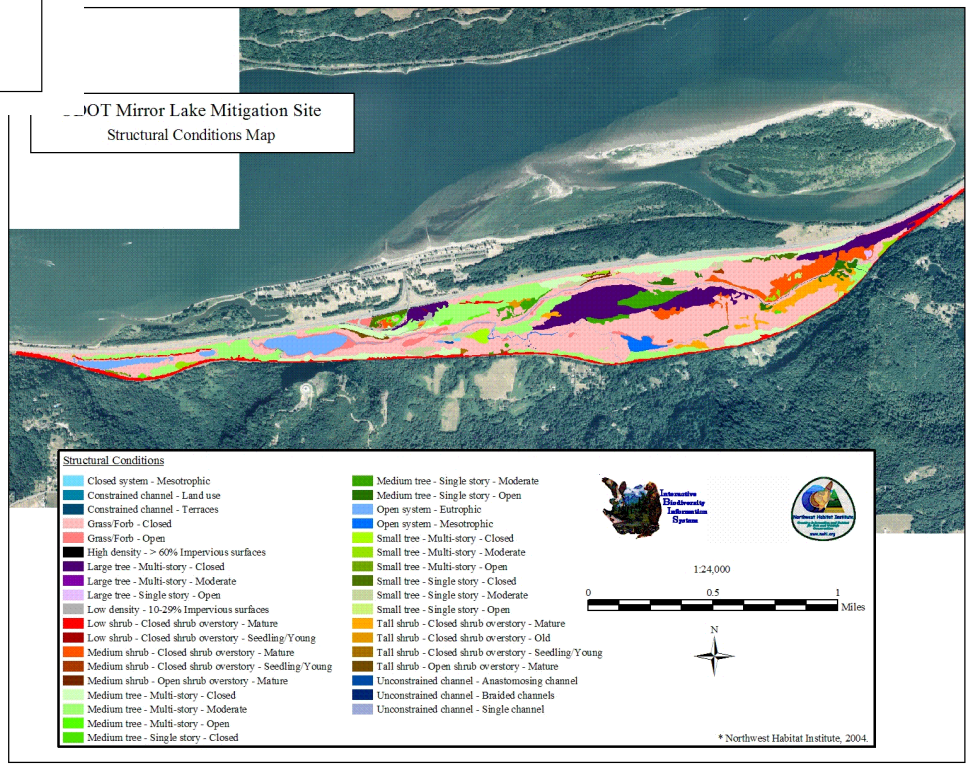
Habitat Classifications

California Wildlife Habitat Types



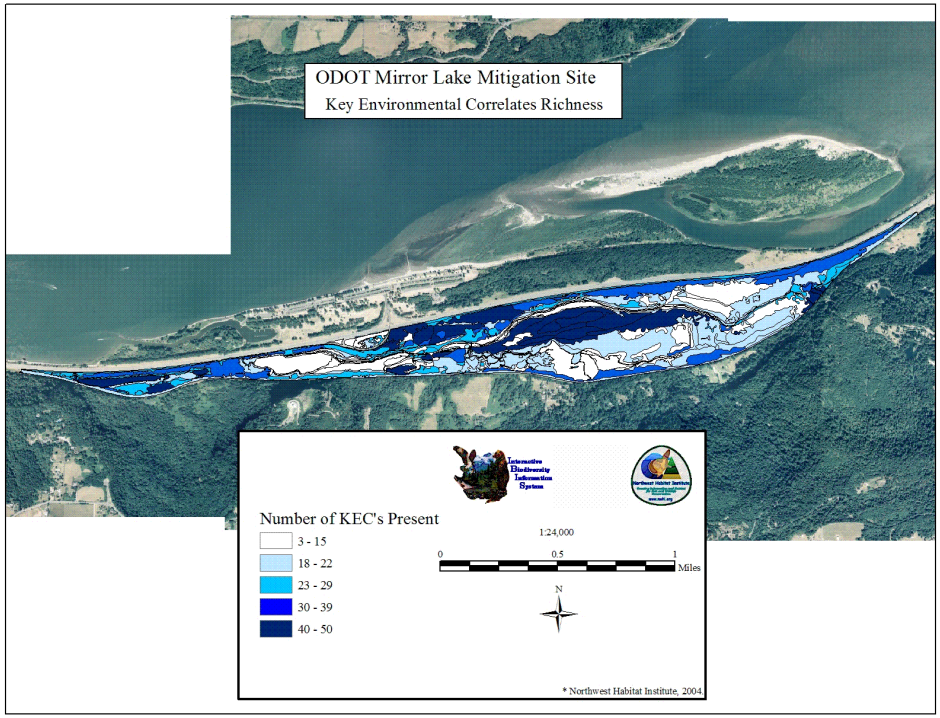


Wildlife-Habitat

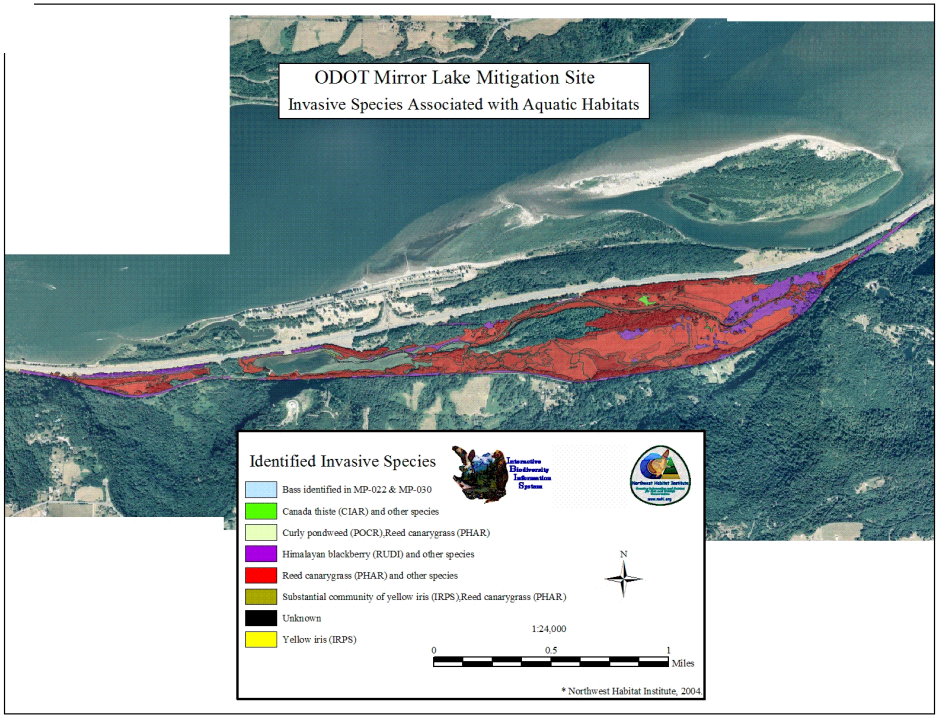

OT Mirror Lake Mitigation Site
Structural Conditions Map
Structural Conditions
Closed system - Mesotrophic
Constrained channel - Land use
Constrained channel - Terraces
Grass/Forb - Closed
Grass/Forb - Open
High density - > 60% Impervious surfaces
Large tree - Multi-story - Closed
Large tree - Multi-story - Moderate
Large tree - Single story - Open
Low density - 10-29% Impervious surfaces
Low shrub - Closed shrub overstory - Mature
Low shrub - Closed shrub overstory - Seedling/Young
Medium shrub - Closed shrub overstory - Mature
Medium shrub - Closed shrub overstory - Seedling/Young
Medium shrub - Open shrub overstory - Mature
Medium tree - Multi-story - Closed
Medium tree - Multi-story - Moderate
Medium tree - Multi-story - Open
Medium tree - Single story - Closed
Medium tree - Single story - Moderate
Medium tree - Single story - Open
Open system - Eutrophic
Open system - Mesotrophic
Small tree - Multi-story - Closed
Small tree - Multi-story - Moderate
Small tree - Multi-story - Open
Small tree - Single story - Closed
Small tree - Single story - Moderate
Small tree - Single story - Open
Tall shrub - Closed shrub overstory - Mature
Tall shrub - Closed shrub overstory - Old
Tall shrub - Closed shrub overstory - Seedling/Young
Tall shrub - Open shrub overstory - Mature
Unconstrained channel - Anastomosing channel
Unconstrained channel - Braided channels
Unconstrained channel - Single channel
1:24,000
0
0.5
1
Miles
N
* Northwest Habitat Institute, 2004.

Structural Conditions

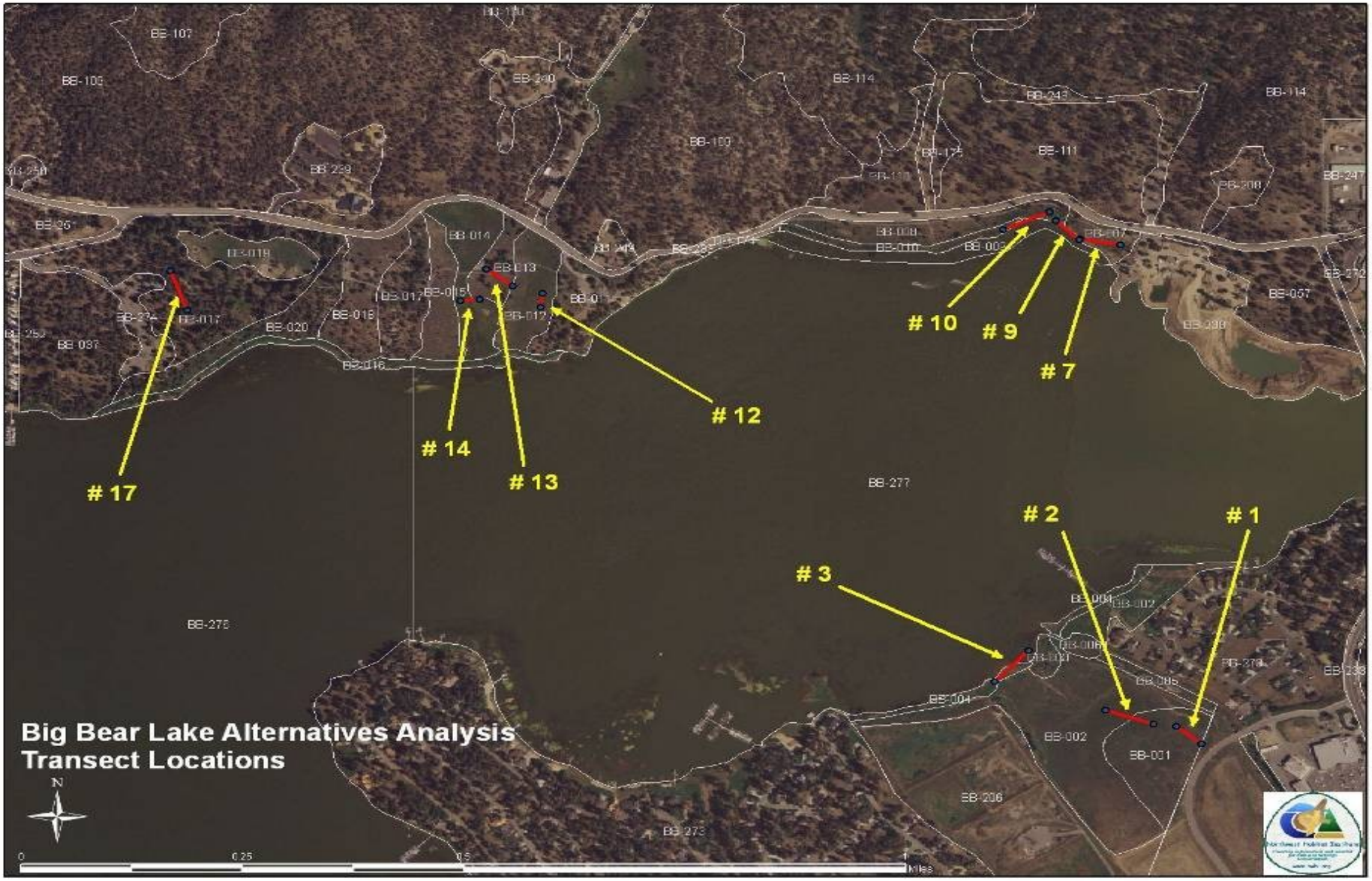
Key Environmental Correlates (KECs)



Invasive Plant Speci



Verification Transects



Habitat Appraisal and Barter (HAB)

What is HAB?

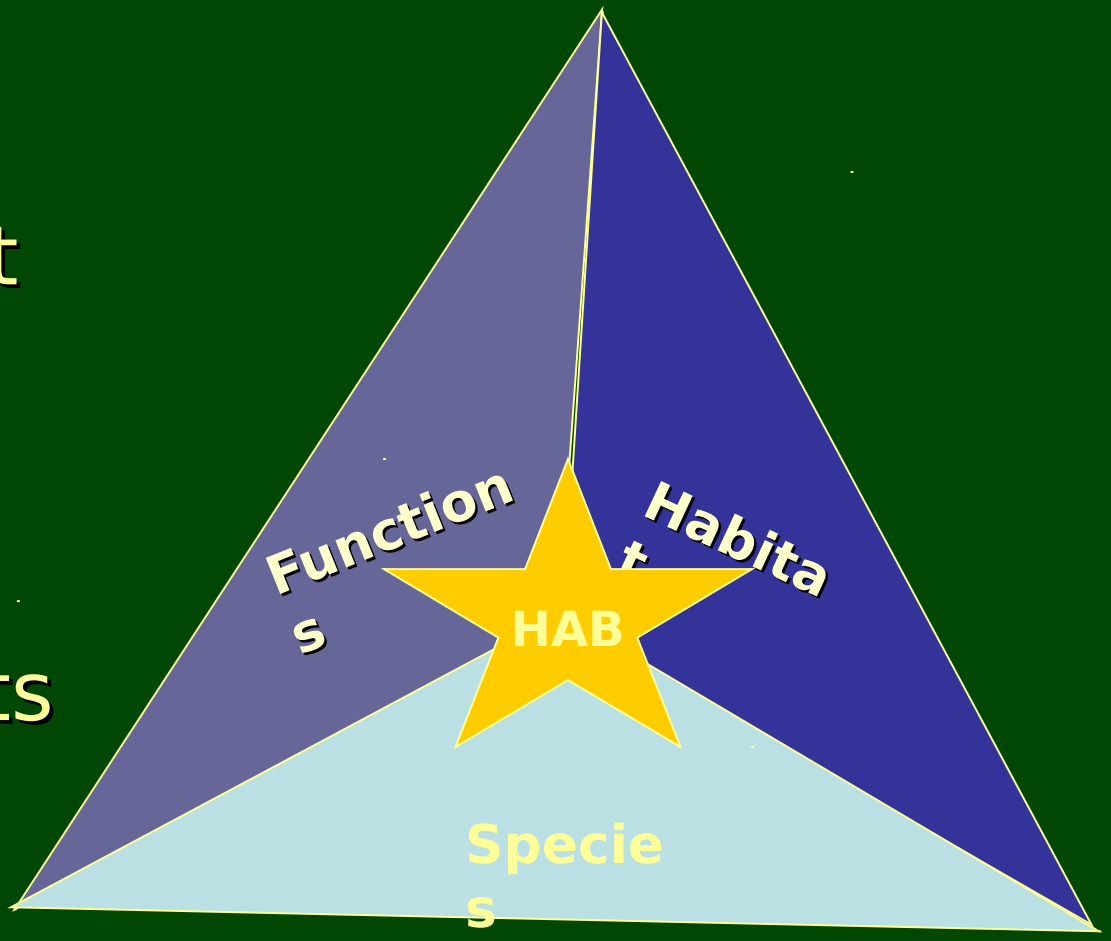
…is a *methodology* that measures habitat quality using diversity, complexity and available habitat size

…implements a new "currency" used for habitat assessment, impact evaluation, and mitigation (used when impacts are unavoidable)

…Uses the IBIS database to link species, habitat, and functions to assess habitat quality

How is HAB different?

- HAB gives quantifiable value to habitat
- HAB is inherently consistent
- HAB implements a triad approach:



How is it determined?

Enhanced Assessment:

- **Wildlife habitat types**
- **Structural conditions**
- **Key environmental correlates**
- **Local condition adjustment factors**
- **Invasive species cover**
- **Potential Species List**
- **Verification – Plant species list and detailed inventory**

Featured Assessment:

- **Wildlife habitat types**
- **Structural conditions**
- **Key environmental correlates**
- **Local condition adjustment factors**
- **Invasive species cover**
- **Potential Species List**

Basic Assessment:

- **Wildlife habitat types**
- **Potential Species List**

HAB method: Process

1) **Preliminary Mapping**
2) **Field Inventory**
3) **Species-Habitat-Functions Relationships (IBIS)**
4) **Calculations**
5) **Final Maps and Reports**

HAB Process: Preliminary Mapping

- **Geo-referenced aerial imagery for site**
- **Habitat types delineated using GIS (in-office)**
  - **Visual land formation differences**
  - **Vegetation (color, texture)**
  - **Structural conditions**

HAB Process: Field Inventory

SITE VISIT

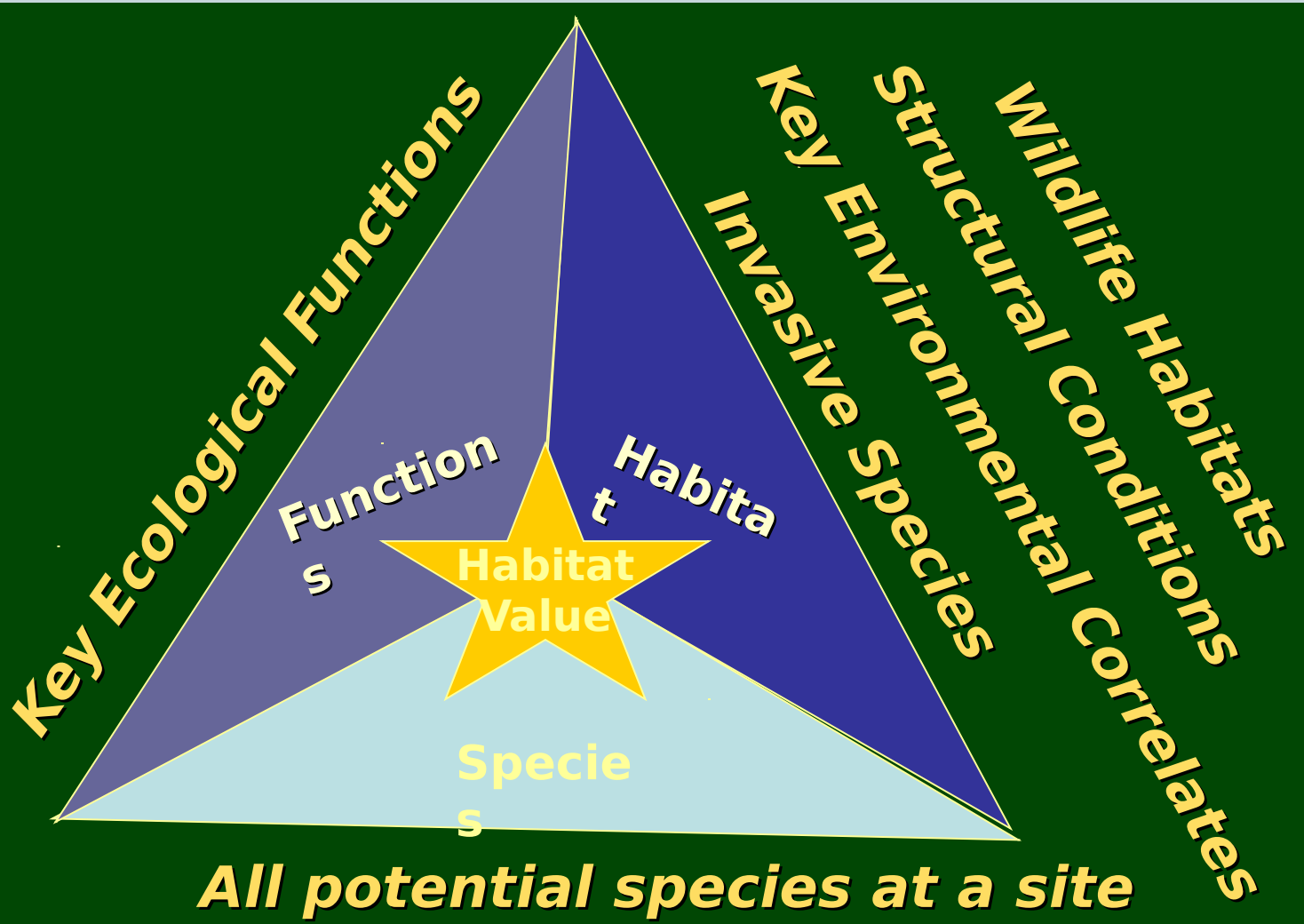
- **Check/refine delineations**
- **For each polygon:**
  - **Record invasive plant abundance**
  - **Record Key Environmental Correlates for each polygon**

HAB method: Relationships IBIS database

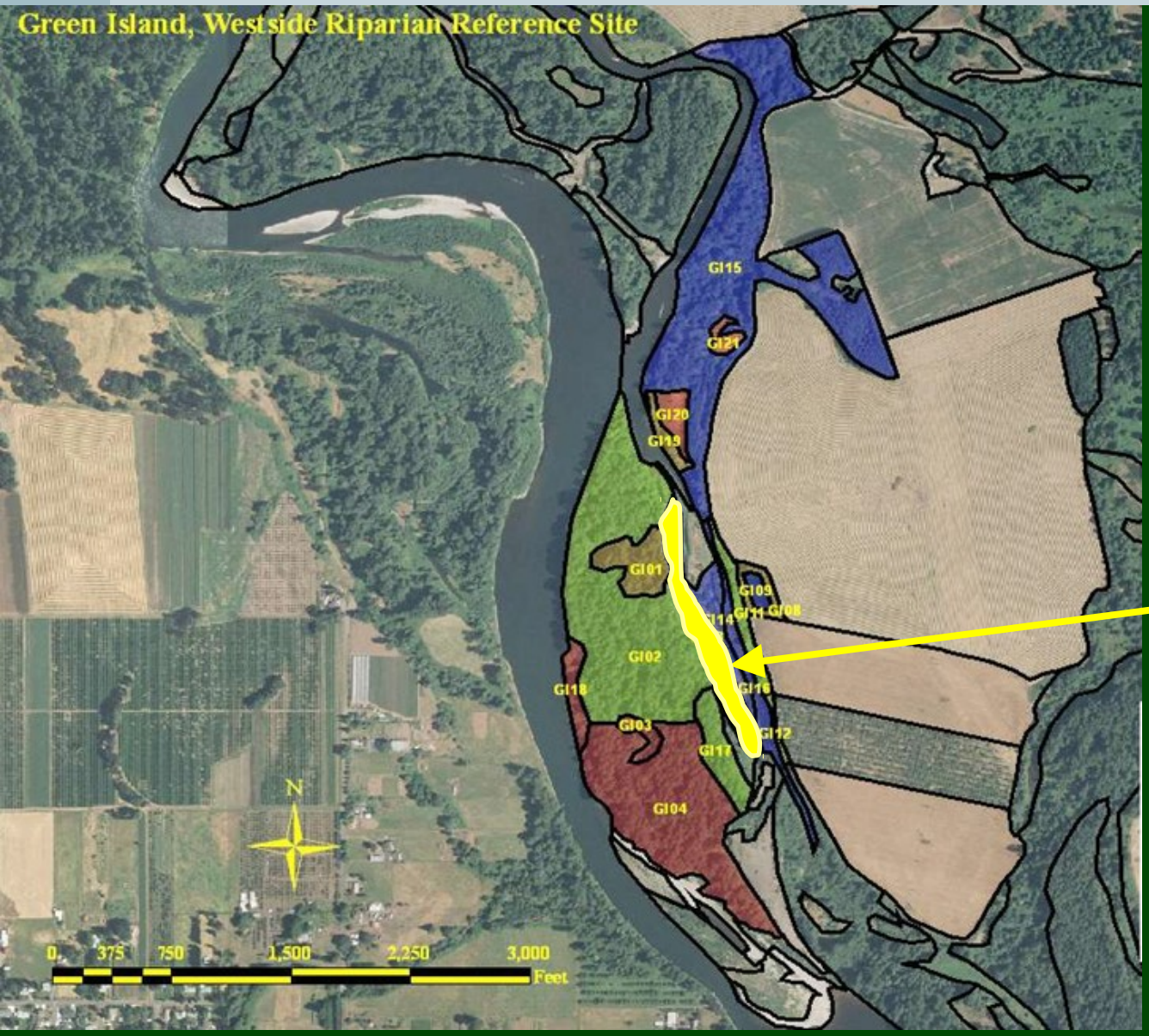
Interactive
Habitat and
Biodiversity
Information
System

- **A collection of wildlife-habitat relationship data integrated into a searchable database**
- **Relationships between: species, habitats, functions**
- **Peer-reviewed; expert panels based on topic**
- **Adaptations used by ODOT, IDFG, Port-of-Portland, Port of Vancouver - EIS, TransAlta - EA**

HAB method: Calculations



HAB Process: Calculations



Information tracked for each polygon at a site.

Big Bear Lake Wildlife Habitat Assessment - Approach

Mean Functional Redundancy Index (MFRI)- is the mean number of species that perform each function associated with a habitat type.

Habitat Type Lowland Mixed Conifer	**Function 1** ***Creates Feeding, Opportunities for Others***	**Function 2** ***Breaks up Down Wood***	**Function 3** ***Primary Excavator***	**Function 4** ***Eats Terrestrial Insects***
Williamson's Sapsucker	**1**	**1**	**1**	**1**
Black Bear	**0**	**1**	**1**	**1**
Red Squirrel	**1**	**0**	**0**	**0**
Great Blue Heron	**1**	**0**	**0**	**1**

KEC Count by KEF for a Project Sites

Habitat types, structural conditions and KECs are usually the main variables **Known** about a

KEC	leaf-eater	fish prey	seed-eater	flower/bud/feeder
down wood in riparian	15	0	27	11
tree cavities	3	0	3	0
herbaceous layer	1	0	1	0
edges	0	0	7	5
shrubs	1	0	12	9

HAB Process: Calculations

Two numbers from each matrix:

1. Total number of “1s” in table

2. Total number of non-zero functions

1. Total # of species performing fxns = 14

2. Total # non-zero fxns =

1. Total # of KECs linked to fxns = 8

2. Total # non-zero fxns =

A

Species ID #	Function ID # 1.3	2.2	2.6	4.5
20170	1	1	1	1
40140	1	1	0	1
43680	1	1	1	1
44870	1	1	1	0

B

KEC ID #	Function ID # 1.3	2.2	2.6	4.5
1.10	0	0	1	1
1.1.3	1	0	0	1
2.4.1	1	0	0	1
2.7.2.1	0	0	1	1

HAB Process: Calculations

Divide: total number of 1s / total number of non-zero functions

A

1. Total # of 1s = 14

2. Total # non-zero fxns = 4

Number of species performing functions / Total number of functions = 14 / 4 = 3.5

B

1. Total # of 1s = 8

2. Total # non-zero fxns = 3

Number of KECs at site / Total number of functions = 8 / 3 = 2.67

Note: Functions Dependent Variable to Species

HAB Process: Calculations

A

$$\frac{\text{Number of species performing functions}}{\text{Total number of functions}} = \frac{14}{4} = 3.5$$

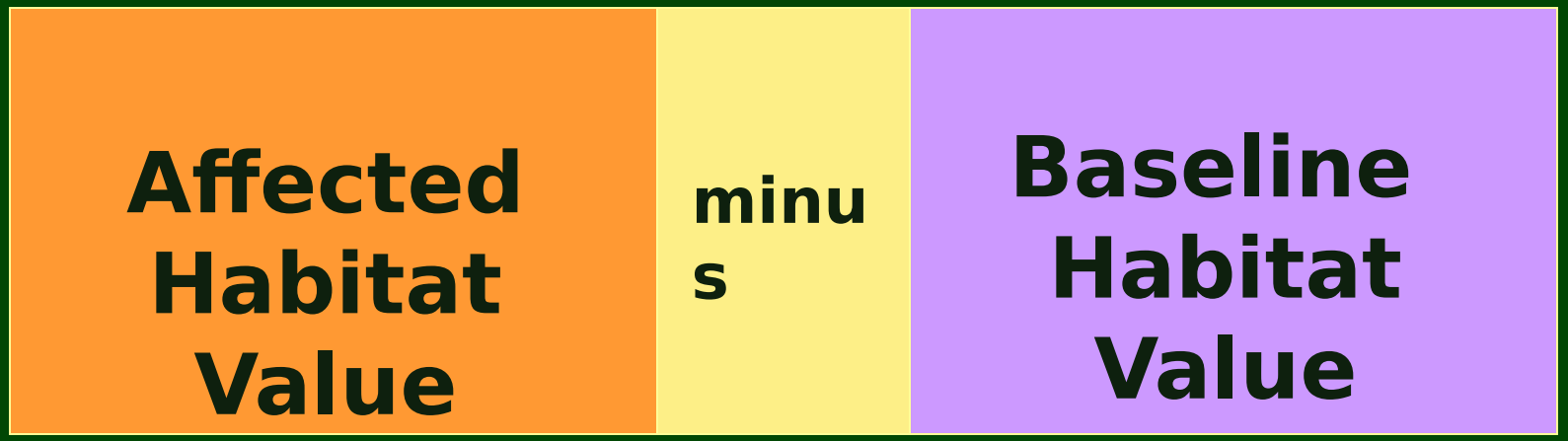
Species Value

B

$$\frac{\text{Number of KECs at site}}{\text{Total number of functions}} = \frac{8}{3} = 2.67$$

KEC Value

Species Value + **KEC Value** = **Habitat Value**



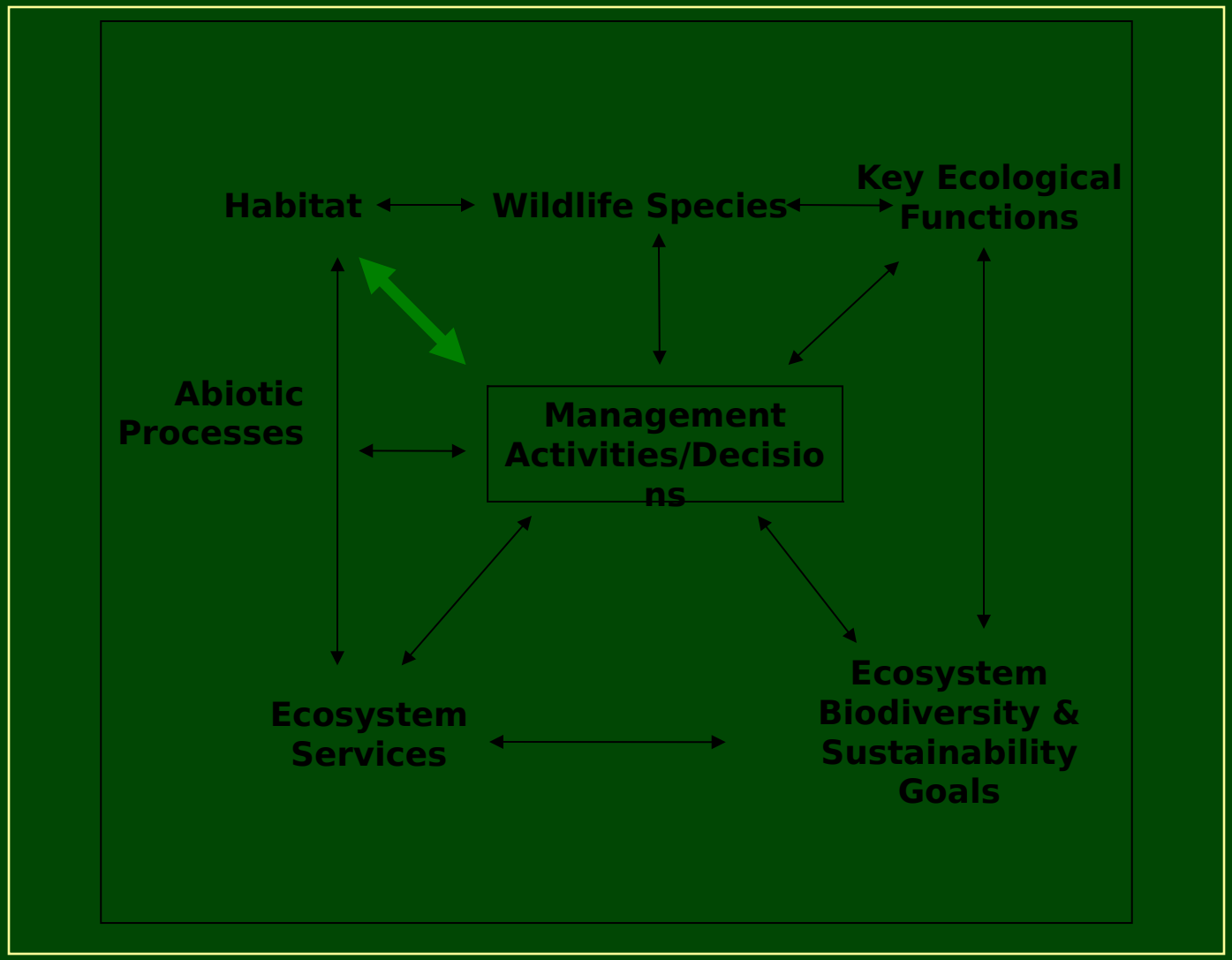
= Impact Value

\- +

Debit

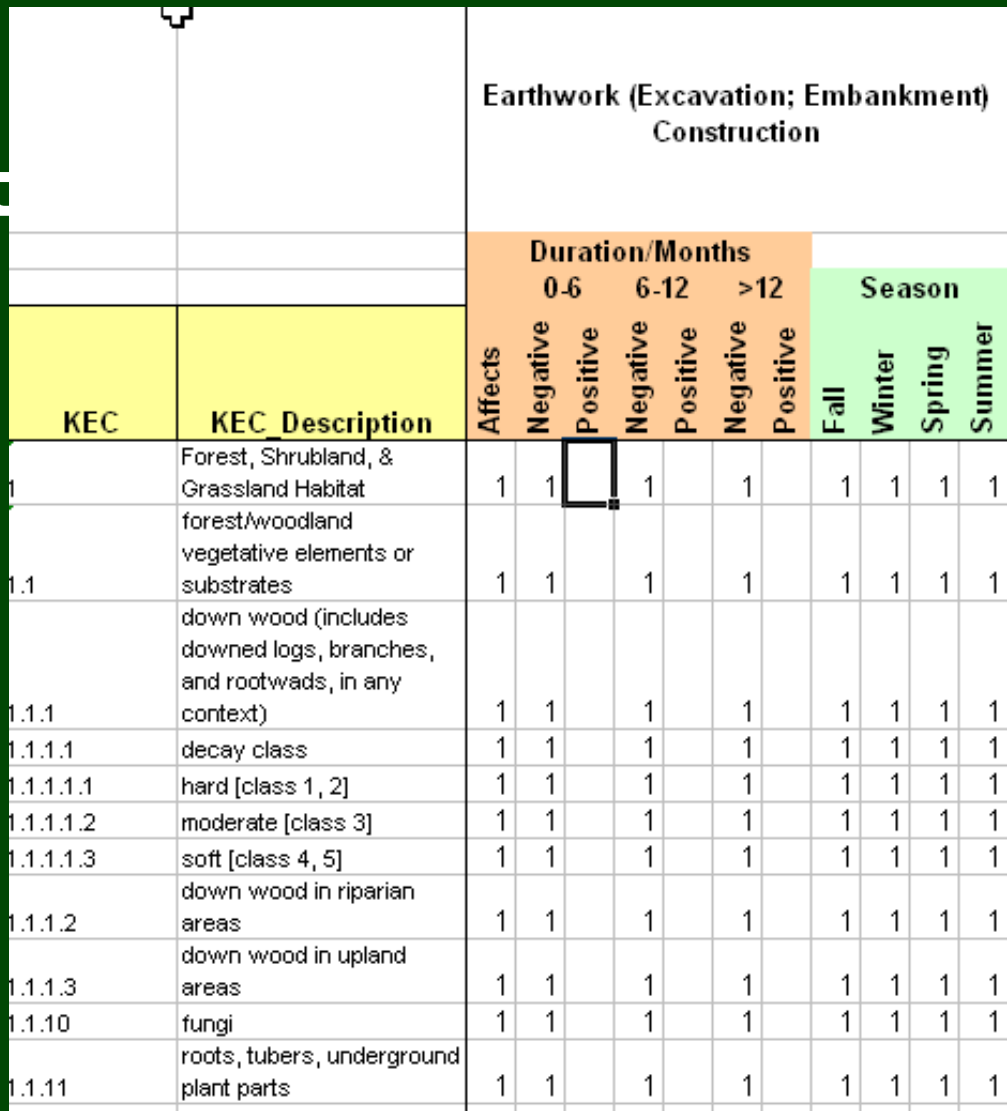
Credit

Influences on Management



Linkages to Management Activities

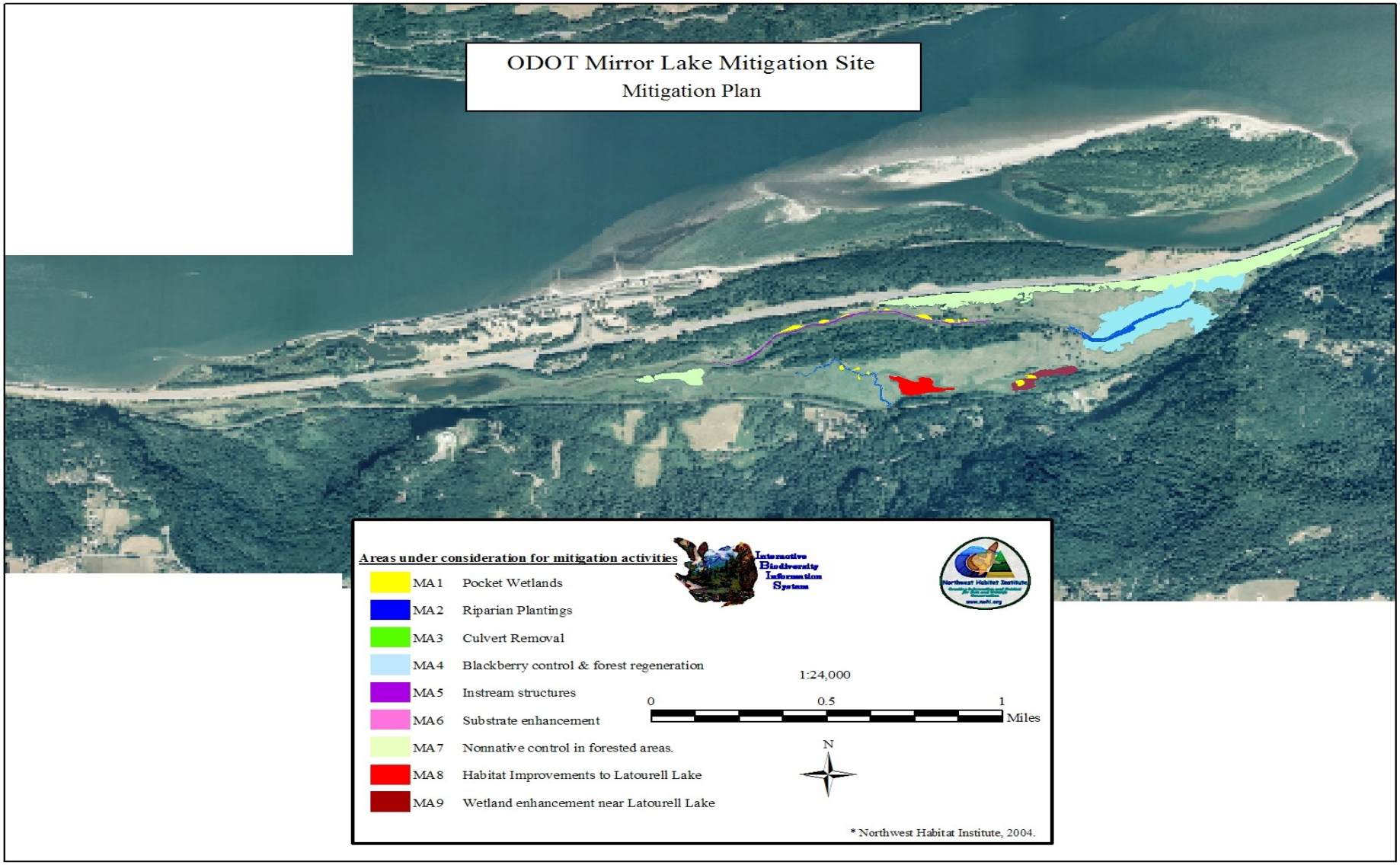
Management Activit
Connected to KECs



Earthwork (Excavation; Embankment) Construction

KEC	KEC_Description	Affects	Duration/Months 0-6 Negative	Duration/Months 0-6 Positive	Duration/Months 6-12 Negative	Duration/Months 6-12 Positive	Duration/Months >12 Negative	Duration/Months >12 Positive	Season Fall	Season Winter	Season Spring	Season Summer
1	Forest, Shrubland, & Grassland Habitat	1	1		1		1		1	1	1	1
1.1	forest/woodland vegetative elements or substrates	1	1		1		1		1	1	1	1
1.1.1	down wood (includes downed logs, branches, and rootwads, in any context)	1	1		1		1		1	1	1	1
1.1.1.1	decay class	1	1		1		1		1	1	1	1
1.1.1.1.1	hard [class 1, 2]	1	1		1		1		1	1	1	1
1.1.1.1.2	moderate [class 3]	1	1		1		1		1	1	1	1
1.1.1.1.3	soft [class 4, 5]	1	1		1		1		1	1	1	1
1.1.1.2	down wood in riparian areas	1	1		1		1		1	1	1	1
1.1.1.3	down wood in upland areas	1	1		1		1		1	1	1	1
1.1.10	fungi	1	1		1		1		1	1	1	1
1.1.11	roots, tubers, underground plant parts	1	1		1		1		1	1	1	1

Link Scenarios and Evaluations Spatially



Special Considerations...

T & E

Federally listed T & E species considered separately

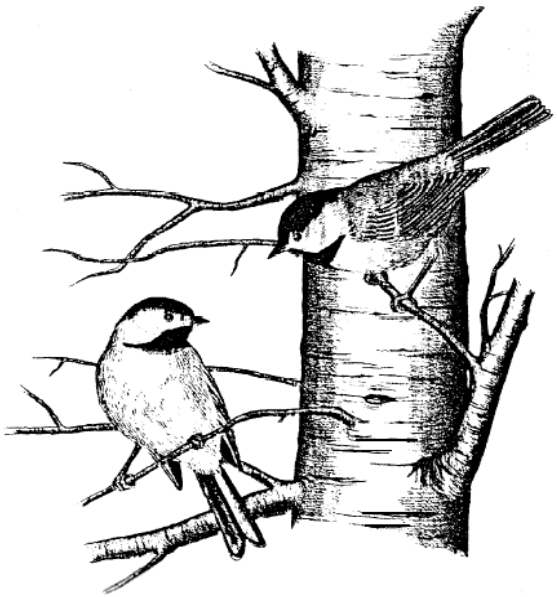
Special consideration for wetlands to ensure no net loss

Wetlan

Habitat Evaluation Procedures (HEP)

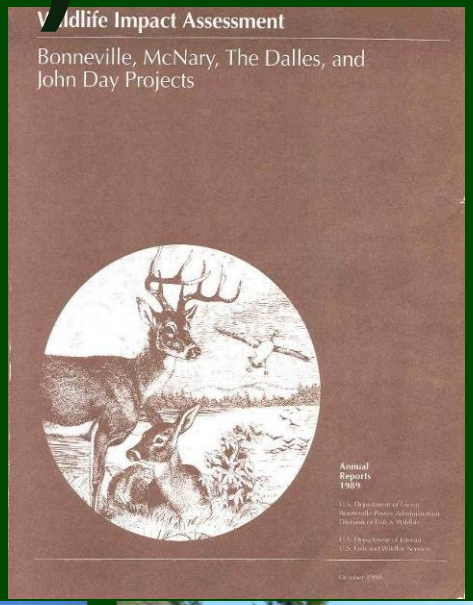
FWS/OBS-82/10.37
APRIL 1983

HABITAT SUITABILITY INDEX MODELS: BLACK-CAPPED CHICKADEE

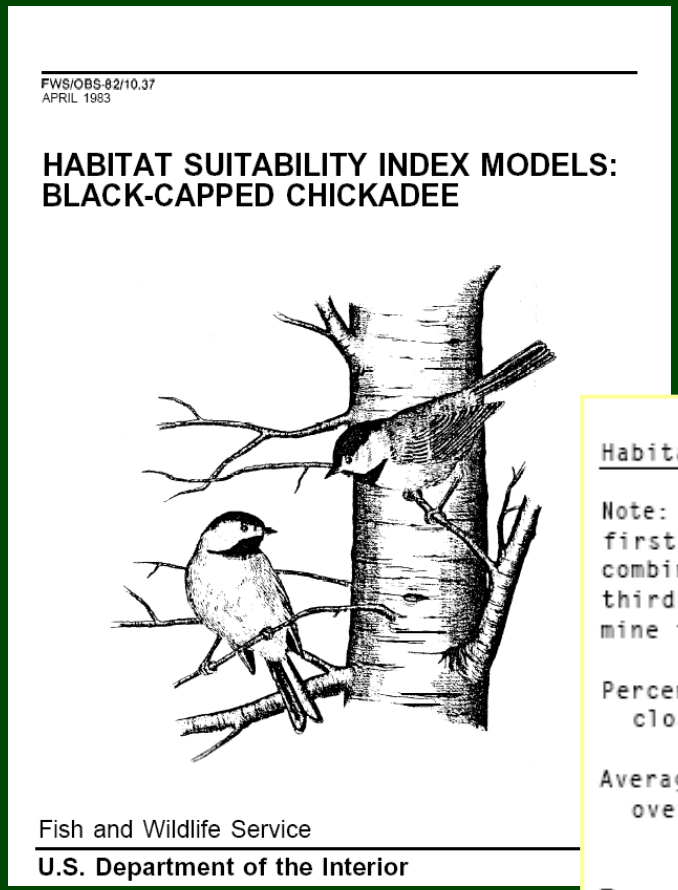


Fish and Wildlife Service

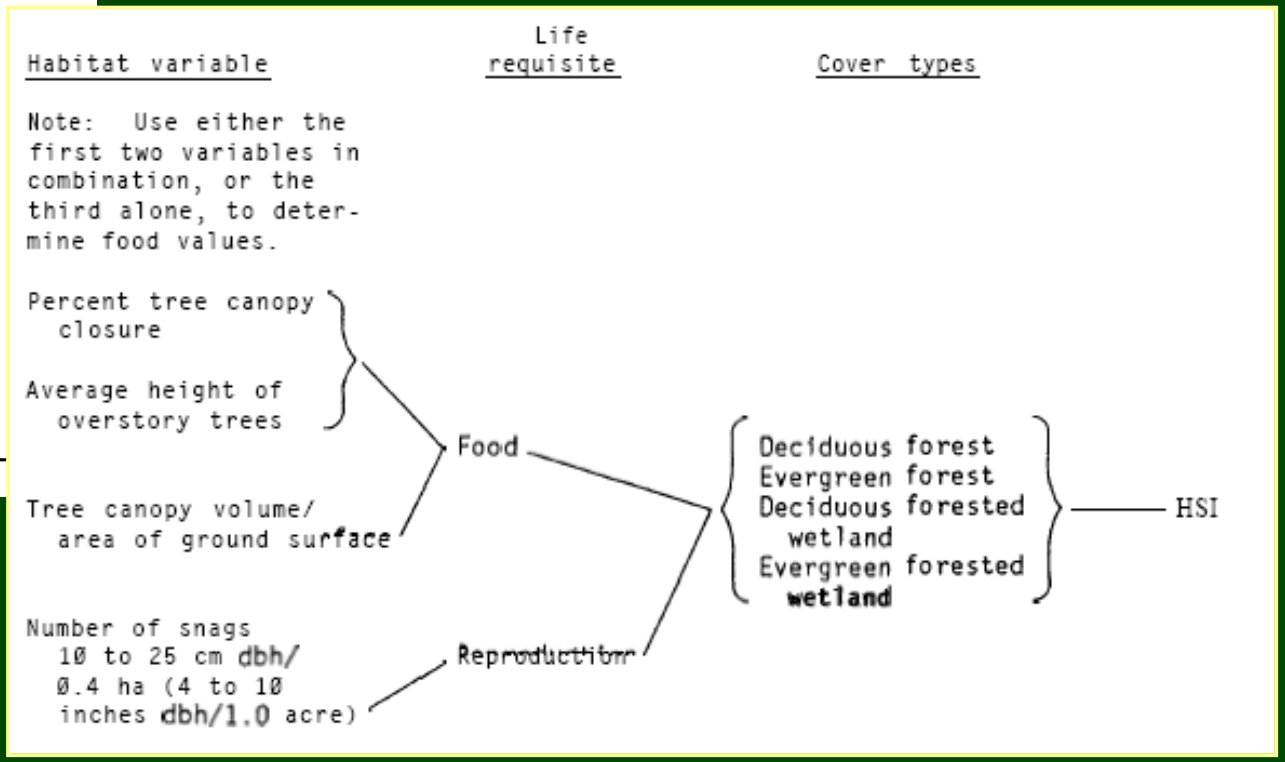
U.S. Department of the Interior



Current method: HEP
What does HEP assess?



HSI Model : Black-capped Chickadee


Habitat variable
Life requisite
Cover types
Note: Use either the first two variables in combination, or the third alone, to determine food values.
Percent tree canopy closure
Average height of overstory trees
Tree canopy volume/ area of ground surface
Number of snags 10 to 25 cm dbh/ 0.4 ha (4 to 10 inches dbh/1.0 acre)
Food
Reproduction
Deciduous forest
Evergreen forest
Deciduous forested wetland
Evergreen forested wetland
HSI

Current method: HEP
What does HEP assess?

HSI Model : Black-capped Chickadee

HEP = # acres x HSI (measure of habitat q
on a scale 0 to 1)

CHAP Rating Process for Habitat Quality

HEP:

- **Habitat Quality x Habitat Quantity = Habitat Units;**
- **Habitat Suitability Index (HSI) = Potential Site Area Conditions x Standard Area of Comparison**

- **Habitat Units = HSI X Area of Available Habi**
- **HEP verification transe**

New Approach

Habitat Appraisal and Barter (HAB) method

HAB + HEP

Combined Habitat Assessment Protocols (CHAP)

Combined Habitat Assessment Protocols (CHAP)

Determine:

- Species List
- Key Ecological Functions
- Existing Key Environmental Correlates (habitat elements)

Goal:

Habitat Quality by Habitat Type

CHAP Rating Process for Habitat Quality

HAB:

- **Habitat Quality Index = More Species, Functions, Habitat types and elements the higher the quality**

By Habitat Type Determine:

- **Potential Number of Species**
- **Actual Habitat Types and Structural Conditions**
- **Actual Key Environmental Correlates**

CHAP Value Conversion to HEP/HSI Values

►Compare Reference Site to Evaluation Site

Site	Per-acre Value
Westside Riparian-Wetland Reference Site (Green Island)	16.81
Westside Riparian-Wetland Evaluation Site (hypothetical)	13.52
Dry Douglas-fir & Oak Reference Site (Bald Top, Finley)	14.92
Dry Douglas-fir & Oak Evaluation Site (hypothetical)	9.77

$$\frac{\text{Per-acre Value}_{eval}}{\text{Per-acre Value}_{ref}} = \text{HQI value}$$

Examples:

13.52 / 16.81 = 0.80 HQI

9.77 / 14.92 = 0.65 HQI

CHAP Value Conversion to HEP/HSI Values

- **HSI is then multiplied by acres:**

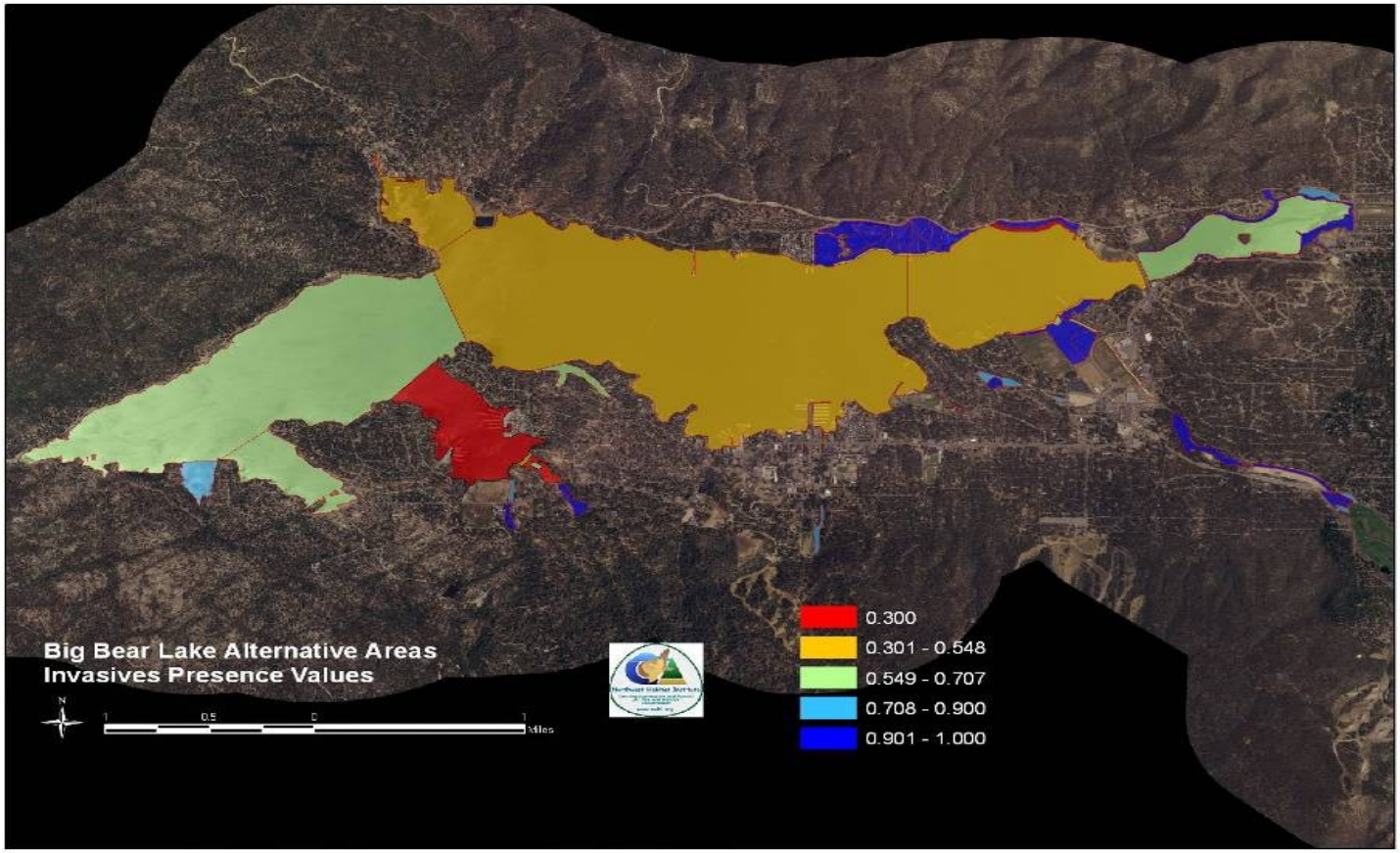
HQI Value x Acreage of Habitat Type = Habitat Units (HUs)

Example: 0.65 HSI x 10 acres = 6.5 HUs

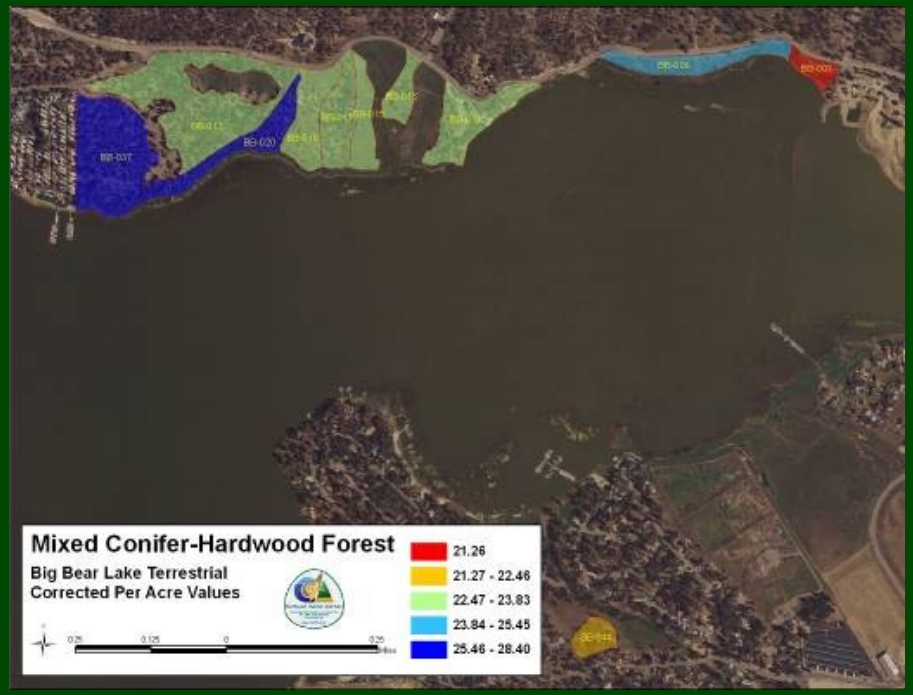
Note: These HUs are different in that they are determined based on numerous species ~ 254 for Big Bear Lake

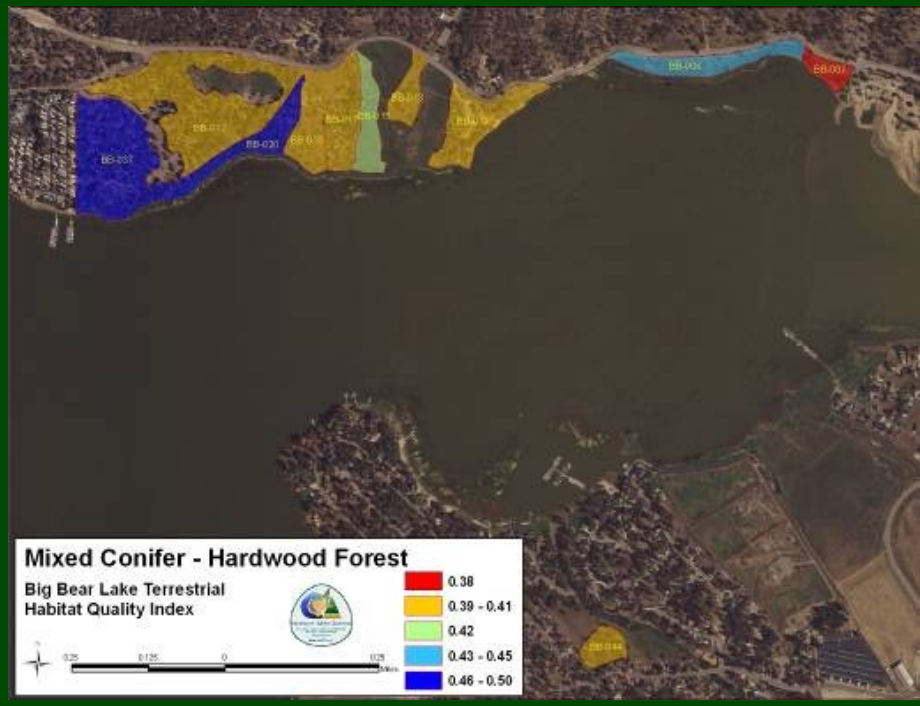
Results

Map of Big Bear Lake and Alternative Sites depicting the invasive species adjustment values

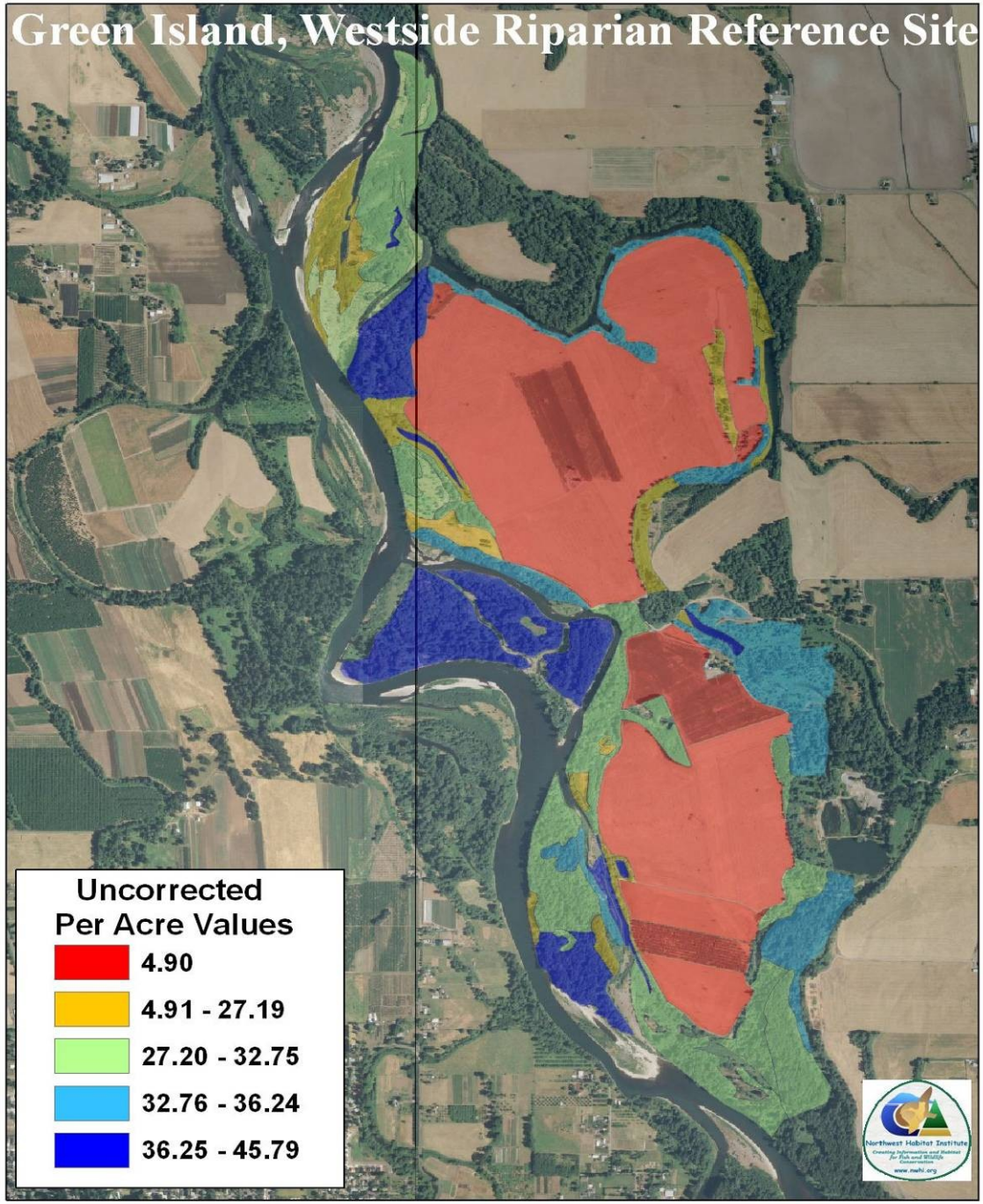


Big Bear Lake Wildlife Habitat Assessment - Results

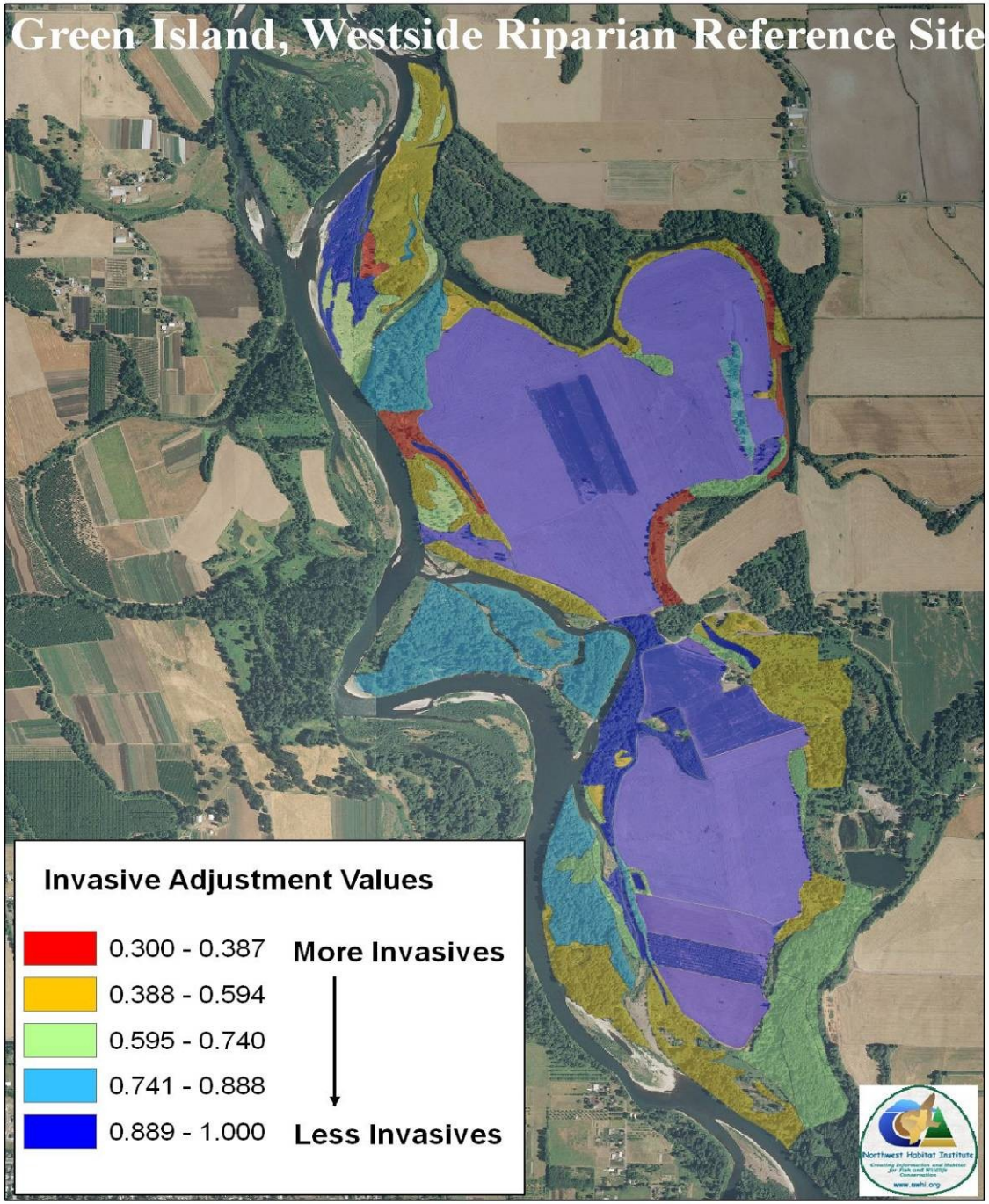




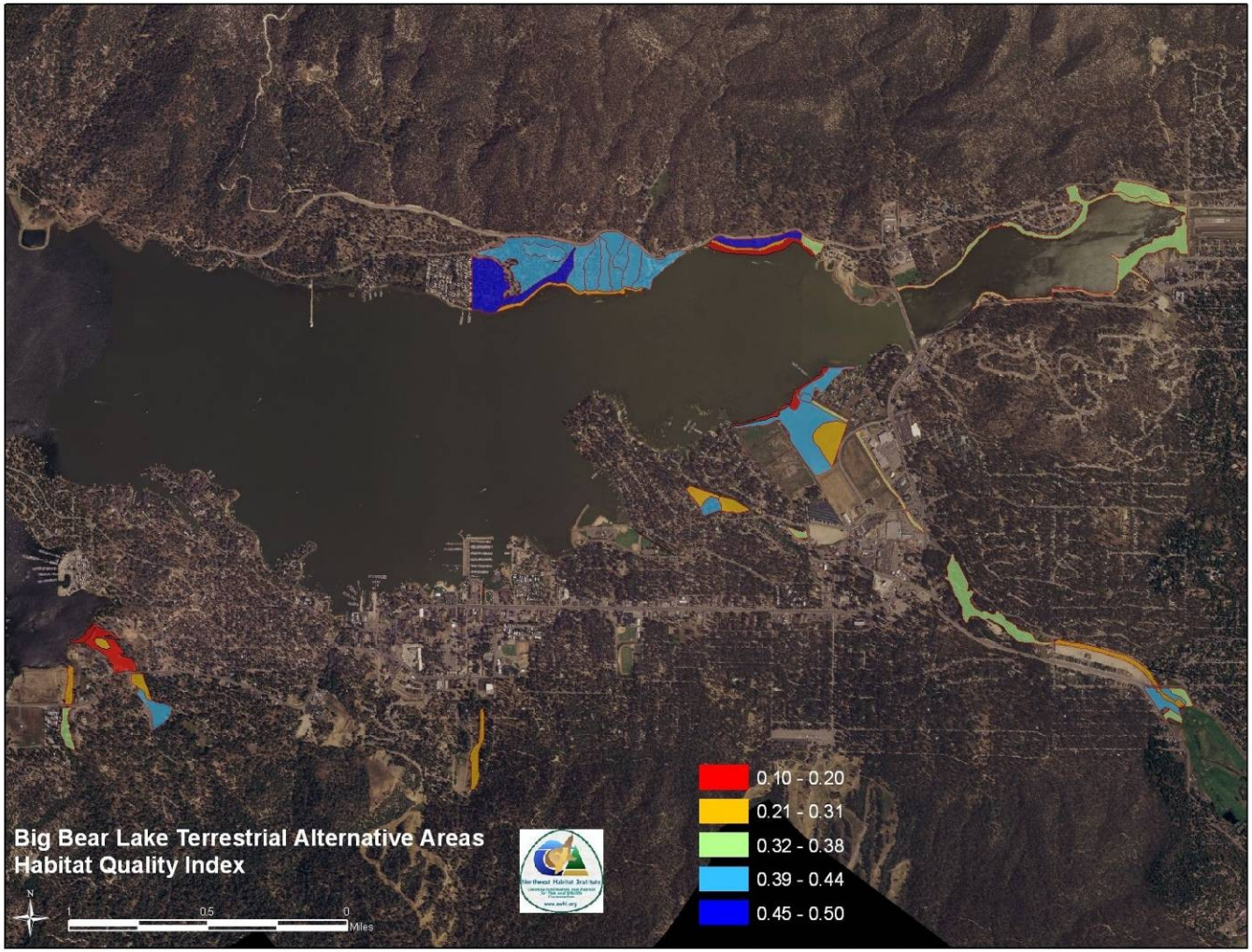
Green Island, Westside Riparian Reference Site



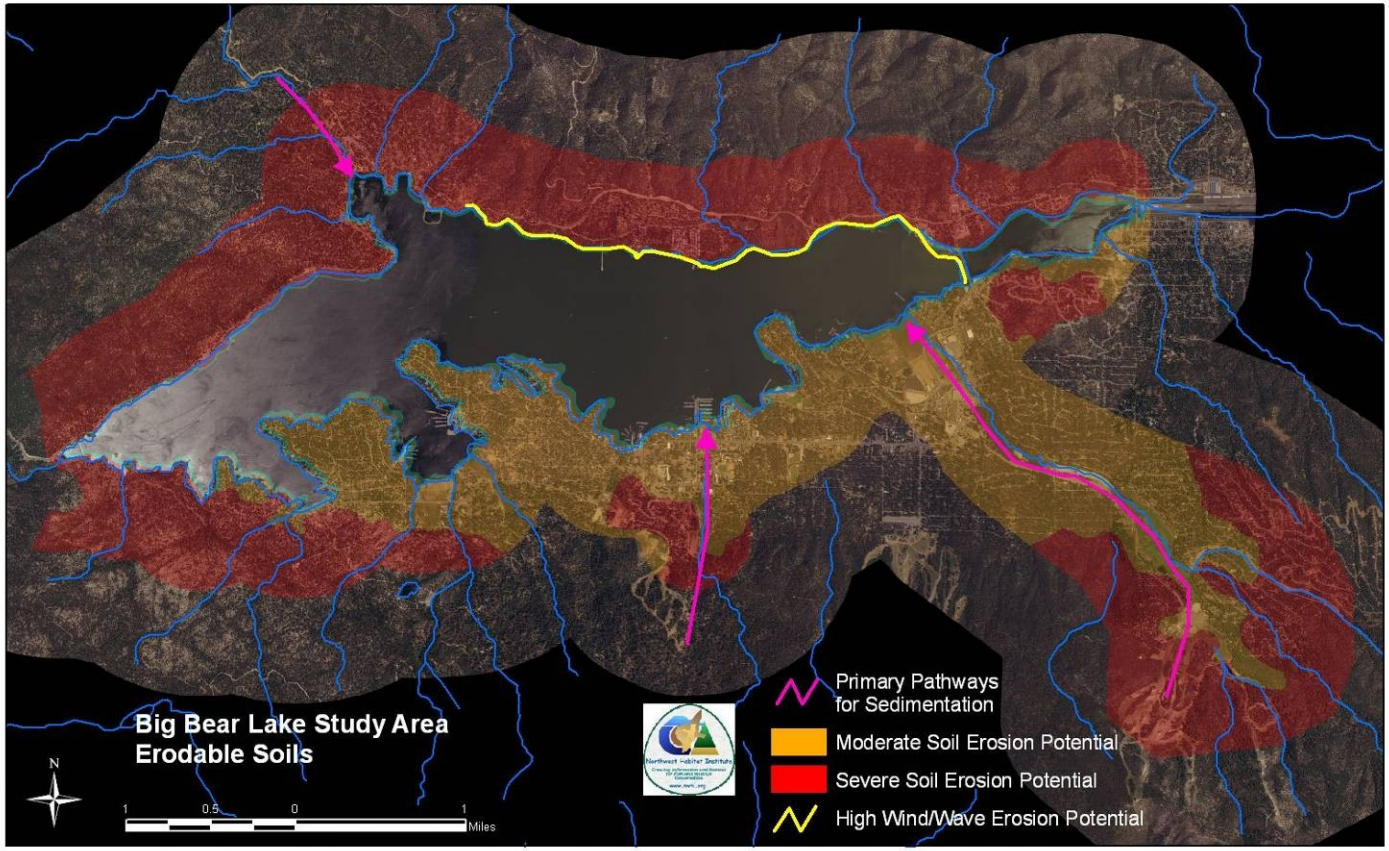
Green Island, Westside Riparian Reference Site



Big Bear Lake Wildlife Habitat Assessment - Results

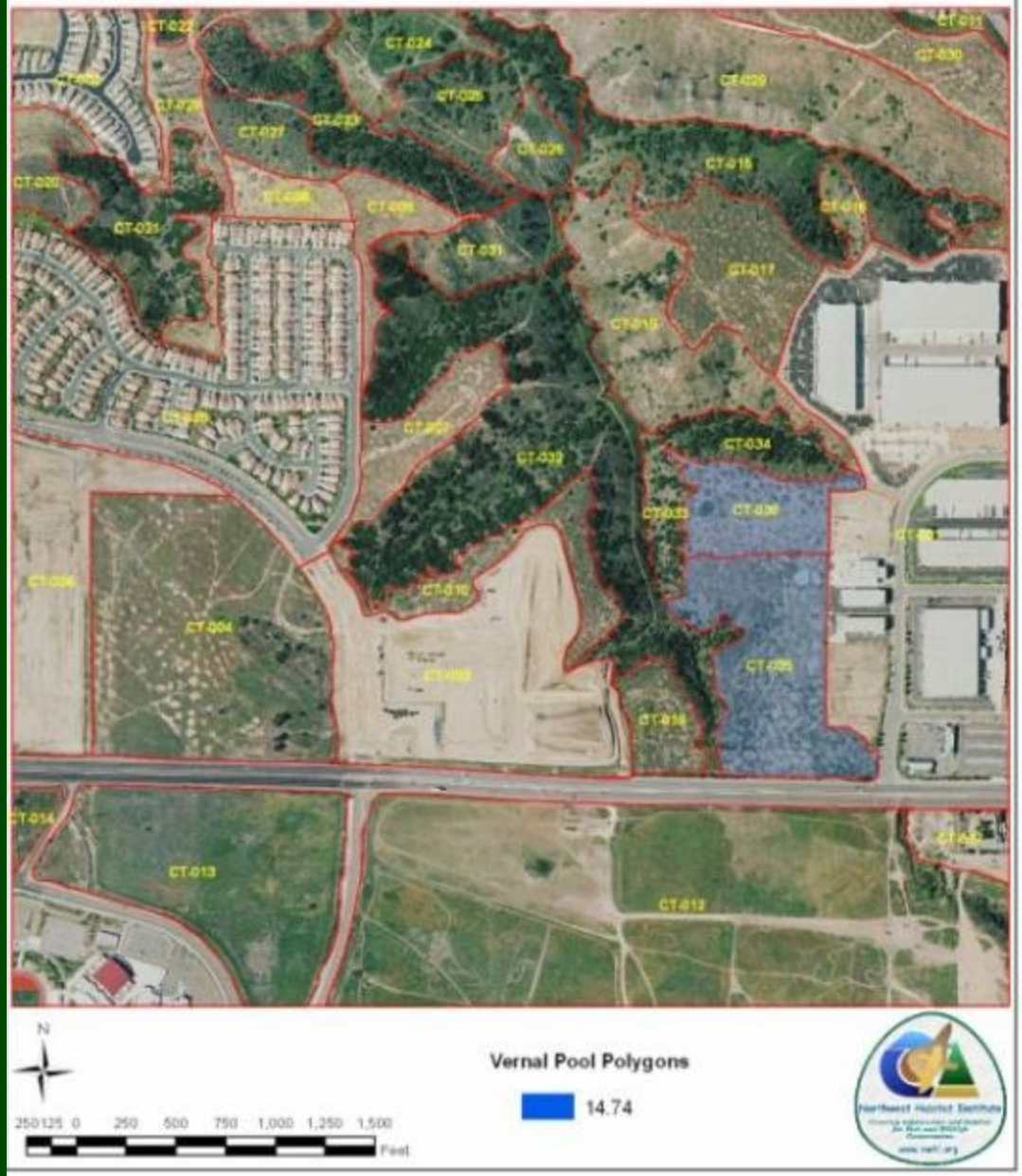


Big Bear Lake Wildlife Habitat Assessment - Results

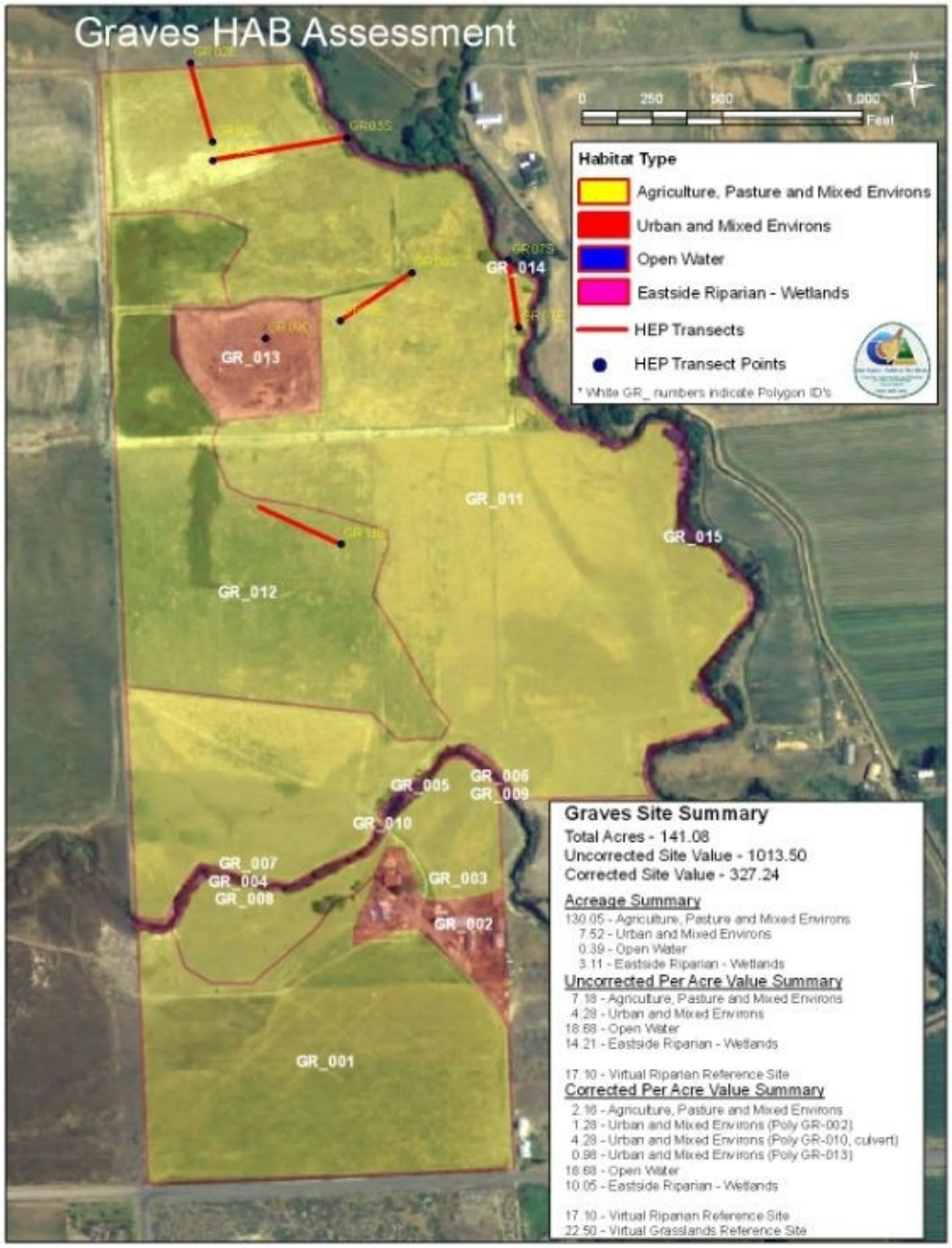


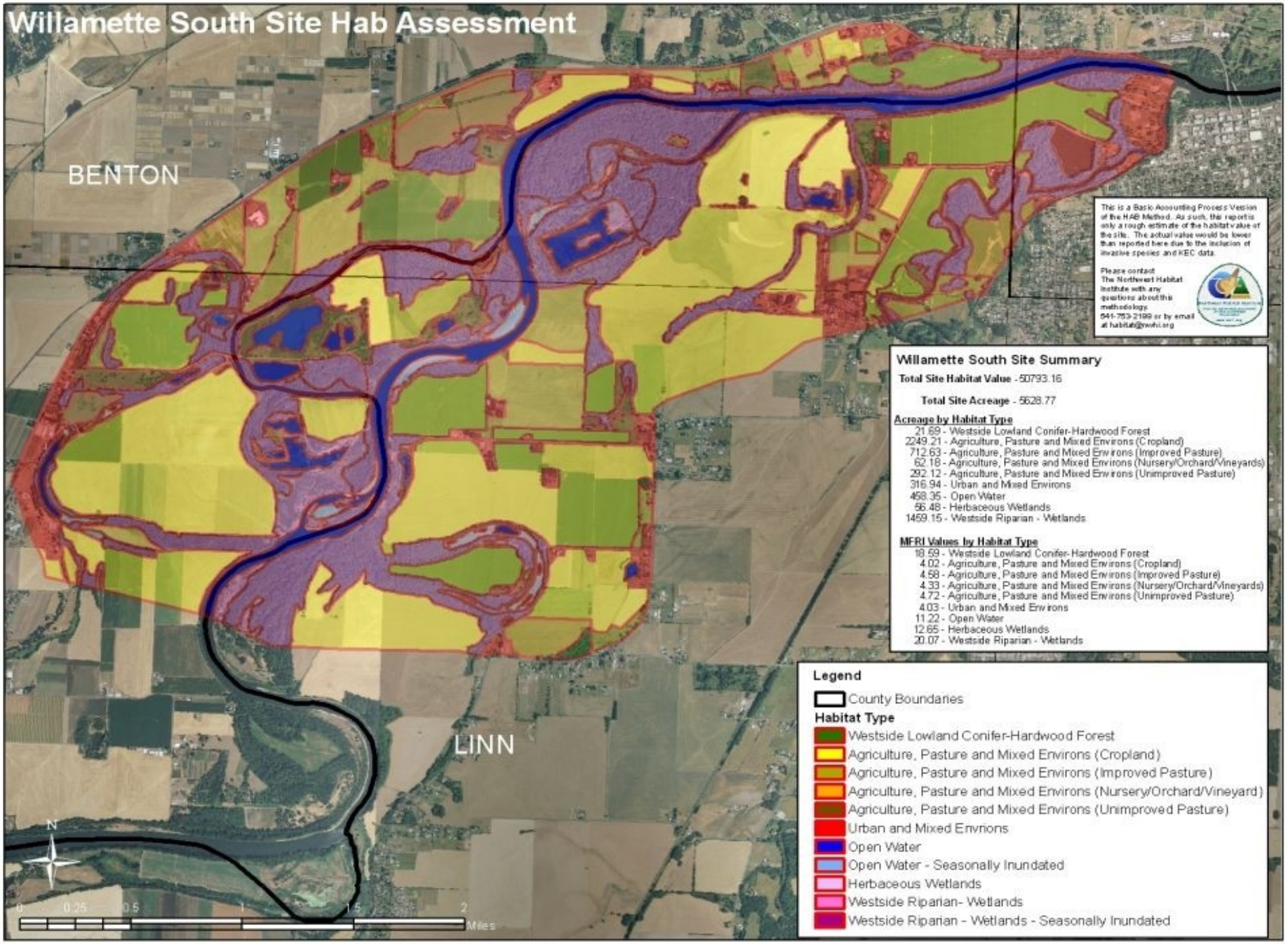
Sweetwater Vernal Pool Site
Corrected Per Acre Habitat Value

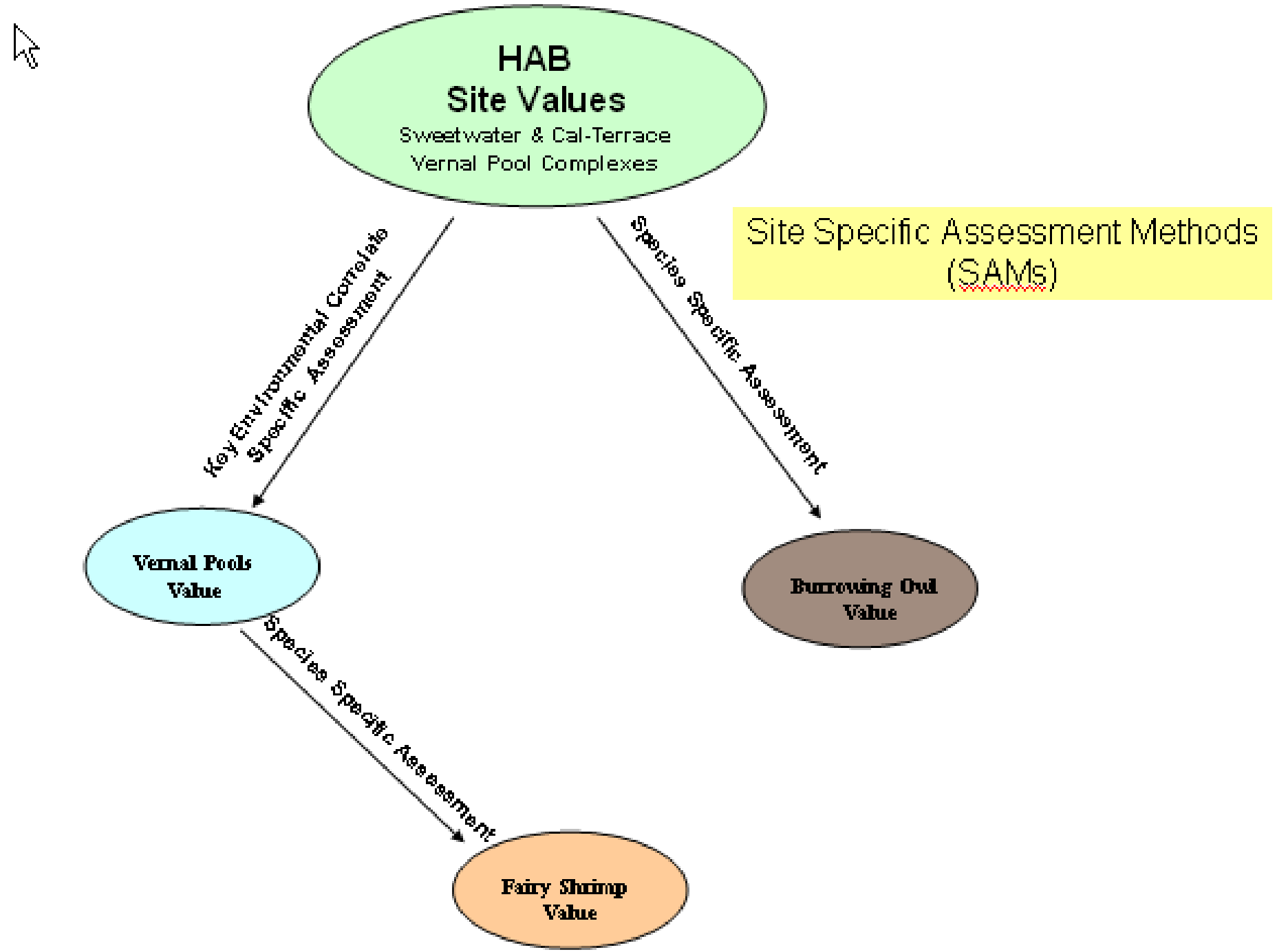
Cal Terrace Reference Site
Corrected Per Acre Habitat Value



Sweetwater Vernal Pool Site
Habitat Quality Index

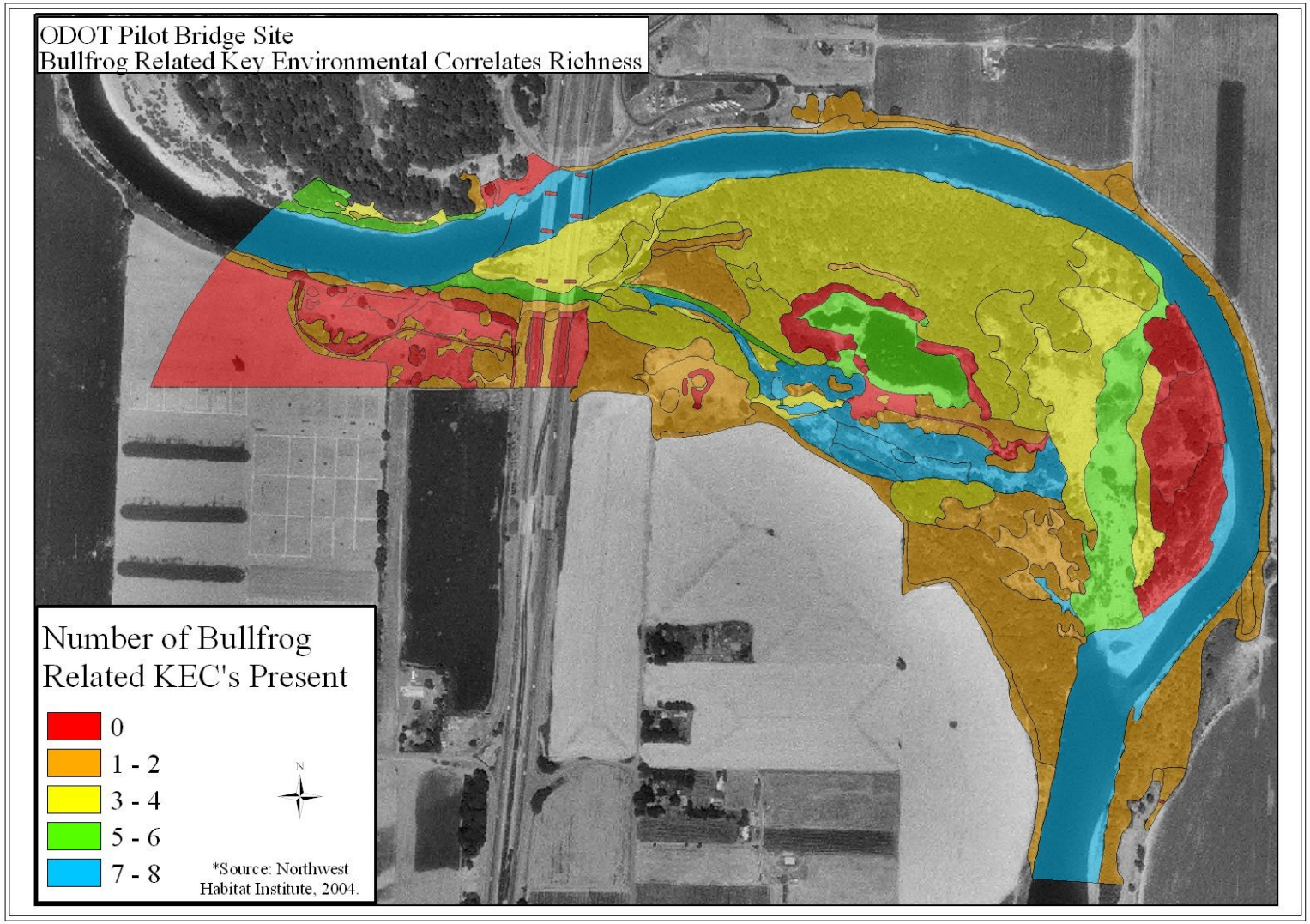

Graves HAB Assessment
0 250 500 1,000
Feet
Habitat Type
Agriculture, Pasture and Mixed Environs
Urban and Mixed Environs
Open Water
Eastside Riparian - Wetlands
HEP Transects
HEP Transect Points
* White GR_ numbers indicate Polygon ID's
GR_013
GR_014
GR_011
GR_015
GR_012
GR_005
GR_006
GR_009
GR_010
GR_007
GR_004
GR_008
GR_003
GR_002
GR_001
Graves Site Summary
Total Acres - 141.08
Uncorrected Site Value - 1013.50
Corrected Site Value - 327.24
Acreage Summary
130.05 - Agriculture, Pasture and Mixed Environs
7.52 - Urban and Mixed Environs
0.39 - Open Water
3.11 - Eastside Riparian - Wetlands
Uncorrected Per Acre Value Summary
7.18 - Agriculture, Pasture and Mixed Environs
4.28 - Urban and Mixed Environs
18.68 - Open Water
14.21 - Eastside Riparian - Wetlands
17.10 - Virtual Riparian Reference Site
Corrected Per Acre Value Summary
2.16 - Agriculture, Pasture and Mixed Environs
1.28 - Urban and Mixed Environs (Poly GR-002)
4.28 - Urban and Mixed Environs (Poly GR-010, culvert)
0.98 - Urban and Mixed Environs (Poly GR-013)
18.68 - Open Water
10.05 - Eastside Riparian - Wetlands
17.10 - Virtual Riparian Reference Site
22.50 - Virtual Grasslands Reference Site


Willamette South Site Hab Assessment
BENTON
LINN
This is a Basic Accounting Process Version of the HAB Method. As such, this report is only a rough estimate of the habitat value of the site. The actual value would be lower than reported here due to the inclusion of invasive species and KEC data.
Please contact The Northwest Habitat Institute with any questions about this methodology. 541-753-2199 or by email at habitat@nwhi.org
Willamette South Site Summary
Total Site Habitat Value - 50793.16
Total Site Acreage - 5628.77
Acreage by Habitat Type
21.69 - Westside Lowland Conifer-Hardwood Forest
2249.21 - Agriculture, Pasture and Mixed Environs (Cropland)
712.63 - Agriculture, Pasture and Mixed Environs (Improved Pasture)
62.18 - Agriculture, Pasture and Mixed Environs (Nursery/Orchard/Vineyards)
292.12 - Agriculture, Pasture and Mixed Environs (Unimproved Pasture)
316.94 - Urban and Mixed Environs
458.35 - Open Water
56.48 - Herbaceous Wetlands
1459.15 - Westside Riparian - Wetlands
MFRI Values by Habitat Type
19.59 - Westside Lowland Conifer-Hardwood Forest
4.02 - Agriculture, Pasture and Mixed Environs (Cropland)
4.58 - Agriculture, Pasture and Mixed Environs (Improved Pasture)
4.33 - Agriculture, Pasture and Mixed Environs (Nursery/Orchard/Vineyards)
4.72 - Agriculture, Pasture and Mixed Environs (Unimproved Pasture)
4.03 - Urban and Mixed Environs
11.22 - Open Water
12.65 - Herbaceous Wetlands
20.07 - Westside Riparian - Wetlands
Legend
County Boundaries
Habitat Type
Westside Lowland Conifer-Hardwood Forest
Agriculture, Pasture and Mixed Environs (Cropland)
Agriculture, Pasture and Mixed Environs (Improved Pasture)
Agriculture, Pasture and Mixed Environs (Nursery/Orchard/Vineyard)
Agriculture, Pasture and Mixed Environs (Unimproved Pasture)
Urban and Mixed Environs
Open Water
Open Water - Seasonally Inundated
Herbaceous Wetlands
Westside Riparian- Wetlands
Westside Riparian - Wetlands - Seasonally Inundated
N
0 0.25 0.5 1 1.5 2
Miles


HAB
Site Values
Sweetwater & Cal-Terrace
Vernal Pool Complexes
Site Specific Assessment Methods
(SAMs)
Key Environmental Correlate
Specific Assessment
Species Specific Assessment
Vernal Pools
Value
Burrowing Owl
Value
Species Specific Assessment
Fairy Shrimp
Value

Cal-Terrace 2001 to 2007

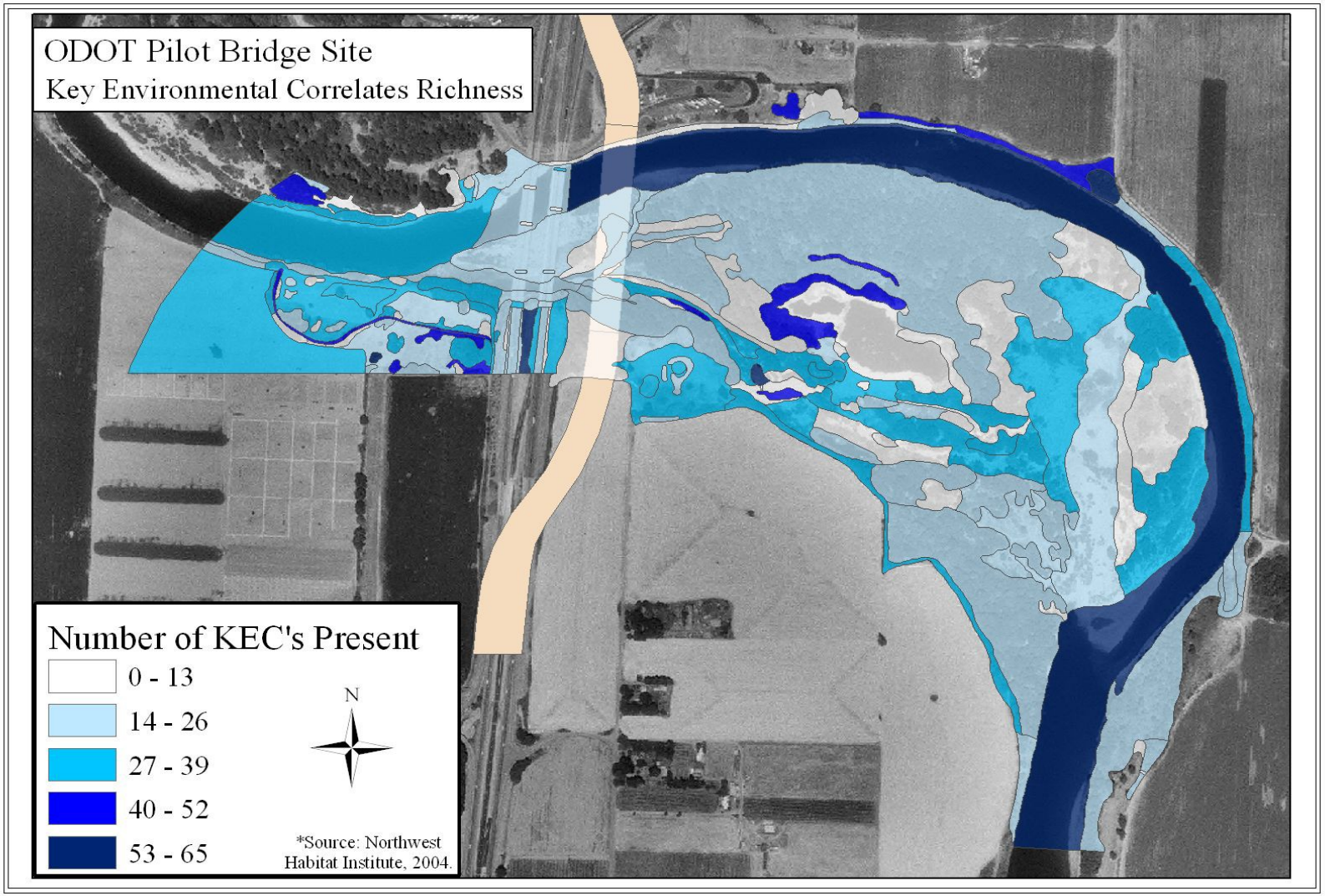
Single Species Evaluation



Tools and products

- Wildlife species range maps
- Transportation planning
- Identifying key ecological functions
- Habitat assessment for conservation and mitigation

Transportation Planning



“ATM”

The HAB methodology is considered an Accounting and Tracking Method (ATM)

Conclusions

Approach provides a consisten methodology for habitat assessment that:

1) Monitors , inventories, and evaluates fish and wildlife habitats
2) Generates consistent map resources to evaluated landscape changes and land use
3) Facilitates monitoring the success of conservation efforts
4) Improves efficiency for impact and mitigation activities

Questions !

Contact Information

Thomas O'Neill

Northwest Habitat Institute

P.O. Box 855

Corvallis, OR

541-753-2199

habitat@nwhi.org